SELECTED WATER RESOURCES ABSTRACTS

VOLUME 4, NUMBER 10
MAY 15, 1971

W71-04851 -- W71-05334

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WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency, Water Quality Office. A directory of the Centers appears on inside back cover.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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02 WATER CYCLE
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03 WATER SUPPLY AUGMENTATION AND CONSERVATION
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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

SPECIFIC CONDUCTANCE AS A MEANS OF ESTIMATING IONIC STRENGTH,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02K.
W71-04975

02. WATER CYCLE

2A. General

THE EFFECT OF SELECTED HYDROLOGIC VARIABLES ON STREAM SALINITY,
Agricultural Research Service, Chickasha, Okla. Soil and Water Conservation Research Div.
H. B. Pionke, and A. D. Nicks.
International Association of Scientific Hydrology Bulletin, Vol 15, No 4, p 13-21, December 1970. 9 p, 5 fig, 4 tab, 7 ref.

Descriptors: *Water quality, *Rainfall-runoff relationships, *Streamflow, *Salinity, Precipitation (Atmospheric), Antecedent precipitation, Regression analysis, Rain gages, Oklahoma.
Identifiers: Stream salinity forecasting.

A relationship of hydrologic variables with stream salinity was determined statistically for two ephemeral streams located in western Oklahoma. The hydrologic variables employed in this study are measures of streamflow, precipitation, antecedent conditions, and agricultural land use. The best single estimate of stream salinity was achieved by use of those variables classed as direct measures of precipitation, with the greatest variability in stream salinity (51%) being predicted by the maximum amount of precipitation received at any rain gage zone in the watershed during one month. Antecedent conditions did not correlate well with stream salinity, except for the variable describing the antecedent stream salinity. Similarly, the areal location of precipitation within the watershed and agricultural land use did not correlate significantly with stream salinity, except for a variable designating the distance between the stream gaging station and the rain gage zone receiving the most precipitation for the month. The best overall estimate of salinity was given by a multiple regression equation chosen on the basis of a factor analysis. This equation accounted for 65% of the variability in salinity and emphasized the contribution of variables classed as direct measures of precipitation. In comparing the two streams, the watershed having the most intensive rain gage network produced the best prediction equation. (Knapp-USGS)
W71-04897

WATER RESOURCES OF EUROPE,
Akademiya Nauk SSSR, Moscow. Institut Geografii.
G. M. Chernogaeva.
International Association of Scientific Hydrology Bulletin, Vol 15, No 4, p 67-76, December 1970. 10 p, 5 fig, 1 tab, 31 ref.

Descriptors: *Water balance, *Runoff, *Hydrologic budget, Hydrology, Water resources, Hydrologic cycle, Climates, Climatology, Mapping, Reviews.
Identifiers: *Water balance (Europe), *Europe.

This paper outlines the results of the research of the water balance of Europe which is a part of the research work on the water balance of the USSR and the continents carried on by the USSR Institute of Geography. The research has been done on the basis of the complex differentiated water balance equations which make it possible to determine major water sources including a soil water component. In Europe the surface runoff varies greatly, from 10 mm in the arid steppes of the European part of the USSR up to 1500 mm and over in the Alpine and neve-glacial belts of mountain areas. An increase in the surface runoff is appreciable on elevations and in mountains, especially on the western slopes of longitudinally elongated mountain ridges as compared with the eastern ones. As a whole, relative values of the European water balance are near to the corresponding values for the whole Earth. (Knapp-USGS)
W71-04899

HYDROLOGIC AND PHOTOGEOLOGIC DETERMINATION OF RAINFALL, RUNOFF, AND GROUNDWATER RELATIONSHIPS IN A DOLOMITE AREA,
Missouri Water Resources Research Center, Rolla; and Missouri Water Resources Research Inst., Rolla.
Vernon A. C. Gevecker, and James C. Maxwell.
Available from NTIS as PB-197 734, $3.00 in paper copy, $0.95 in microfiche. Completion Report, Jan 15, 1971. 14 p, 2 tab, 4 fig. OWRR Project A-013-MO (1).

Descriptors: *Runoff, *Recharge, *Groundwater, Water wells, Rainfall-runoff relationships, Missouri, *Photogrammetry, Dolomite.
Identifiers: *Ozark watershed.

The goal was to determine the procedures needed to evaluate availability and disposition of surface and subsurface waters in an 18 square mile Ozark watershed underlain by partially cavernous dolomite. Hydrologic objectives were compilation and analysis of rainfall and streamflow records to estimate losses of surface water and recharge to groundwater. Photogeologic objectives were to identify, map and measure soils, vegetation, land use, sinkholes, linears, and drainage patterns. Stream recording was interrupted by bed load which blocked recorder inlets, by highway crews who altered channels, and by flood loss of a recorder house. Flows at high stages were unobtainable because of their infrequency, unpredictability and short duration. Rainfall was measured by volunteers. Soil types were identified on airphotos and mapped. Land use and vegetation were also photo-mapped. Water wells, located by field interviewing and measured when possible, were mapped. Stream losses in the upper creek were not calculable but in the lower reaches were 18 cubic feet per second. Runoff of 5.1 to 5.4 inches per square mile was 12 to 14 percent of the annual rainfall of 37 to 41 inches. (Maxwell-Missouri)
W71-04937

A METHOD FOR RELATING INFILTRATION RATES TO STREAMFLOW RATES IN PERCHED STREAMS,
Geological Survey, Tucson, Ariz.
For primary bibliographic entry see Field 02F.
W71-04971

SYNTHESIZING HYDROGRAPHS FOR SMALL SEMIARID DRAINAGE BASINS,
Geological Survey, Cheyenne, Wyo.
G. S. Craig, Jr.
For sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D238-D243, 1970. 6 p, 6 fig, 1 tab, 1 ref.

Descriptors: *Hydrograph analysis, *Peak discharge, *Ephemeral streams, Hydrographs, Frequency analysis, Wyoming, Rainfall-runoff relationships, Arid lands, Runoff forecasting, Streamflow forecasting.
Identifiers: Hydrograph synthesis.

Studies of hydrograph shape for 14 small (less than 11 sq mi) drainage basins led to the development of a possible standard dimensionless hydrograph for semiarid regions. The dimensionless hydrograph, described in detail, was developed with data from small, ephemeral streams in Wyoming. Hydrographs are synthesized from the dimensionless hydrograph by using peak discharge-volume relationships. Only the single-peak event is considered. Synthetic hydrographs produced from the Wyoming dimensionless hydrograph show close agreement with observed hydrographs from Wyoming, New Mexico, and Arizona. The procedure can be used to define a hydrograph for any selected design value of peak frequency. (Knapp-USGS)
W71-04972

THE EFFECT OF STREAM DISCHARGE ON STREAMBED LEAKAGE TO A GLACIAL OUTWASH AQUIFER,
Geological Survey, Columbus, Ohio.
For primary bibliographic entry see Field 02F.
W71-04973

MASS, MOMENTUM, AND ENERGY BUDGET EQUATIONS FOR BOMAP COMPUTATIONS,
National Oceanic and Atmospheric Administration, Rockville, Md., The BOMAP Office.
Eugene M. Rasmusson.
National Oceanic and Atmospheric Administration Technical Memorandum ERL BOMAP-3, January 1971. 32 p, 1 fig, 4 ref, 4 append.

Descriptors: *Model studies, *Atmosphere, *Water vapor, *Hydrologic budget, *Mathematical models, Oceans, Mass, Momentum transfer, Energy, Pressure, Equations, Latent heat, Radiation, Hydrologic data, Data collections, Ships, Aircraft, Air masses, Meteorology, Climatology, Synoptic analysis.
Identifiers: BOMEX project.

Basic atmospheric budget equations were modified for use in computing the budgets of mass, momentum, and energy for the atmospheric part of the BOMEX volume, as related to the Barbados Oceanographic and Meteorological Experiment (BOMEX), May-July, 1969. Observations made during the Experiment were to estimate the total transfer of water vapor, sensible heat, and momentum from sea to air over a 500- by 500-km square. This was done by measuring the quantities entering into the continuity or conservation equation for each property, with sufficient time and space resolution to allow the integrals over the 500-km square, through approximately the lower 6 km of the atmosphere, and over a time period of 1 day. These integrated conservation equations are called the 'budget equations.' (Woodard-USGS)
W71-05052

AVERAGE ANNUAL PRECIPITATION AND RUNOFF IN NORTH COASTAL CALIFORNIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W71-05096

WATER RESOURCES OF THE WILD RICE RIVER WATERSHED, NORTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W71-05113

WATER RESOURCES OF THE RED LAKE RIVER WATERSHED, NORTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W71-05114

REGIONALITIES OF CLIMATIC VARIATIONS OF THE WORLD,
Tokyo Metropolitan Univ. (Japan). Faculty of Science.
For primary bibliographic entry see Field 02B.
W71-05199

2B. Precipitation

A COMPARISON OF ENERGY BALANCE METHODS FOR ESTIMATING ATMOSPHERIC THERMAL RADIATION,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02D.
W71-04852

SPLASH AMOUNTS FROM WATERDROP IMPACT ON A SMOOTH SURFACE,
Agricultural Research Service, Morris, Minn. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02J.
W71-04865

FACTORS AFFECTING VARIATIONS OF MEAN ANNUAL RAINFALL IN ISRAEL,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.
M. H. Diskin.
International Association of Scientific Hydrology Bulletin, Vol 15, No 4, p 41-49, December 1970. 9 p, 1 fig, 5 tab, 4 ref.

Descriptors: *Rainfall disposition, *Distribution patterns, Regression analysis, Rain gages, Variability, Arid lands, Precipitation (Atmospheric), Synoptic analysis, Isohyets, Weather data, Data collections.
Identifiers: *Israel.

A stepwise multiple linear regression analysis was used to study factors that affect the mean annual rainfall in Israel. The factors investigated were latitude, elevation, and easterly distance from the sea. Separate equations, relating the 30-year mean rainfall to these factors were derived for the northern and southern parts of the country. The regression equations reduced most of the variance of the rainfall data for the 211 rain-gaging stations included in the study. The three factors found to affect the mean annual precipitation in the northern half of the country were the latitude of the rain-gaging station, its elevation, and its longitude or easterly distance from the shore line. In the southern half of the country only the latitude and longitude appear to affect significantly the magnitude of the mean annual precipitation. Mean annual rainfall increased with the latitude of the station and with its elevation and decreased with the longitude of the station or its easterly distance from the sea. The orographic effect on mean annual precipitation in the northern half of Israel is of the order of 30 mm increase in precipitation for each 100 meters increase in elevation. The effect of longitude or easterly distance from the sea is of the order of 290 mm per degree of longitude or about 3.1 mm/km for the northern part of the country and 140 mm per degree or 1.5 mm/km in the southern part. A change of latitude of one degree causes a change of precipitation of about 210 mm (1.9 mm/km) in the norther part of the country and about 120 mm (1.1 mm/km) in the south. If the change in latitude is not made along the meridian, but along a line parallel to the shoreline, the change in the mean annual precipitation in the northern part is about 100 mm (0.9 mm/km). (Knapp-USGS)
W71-04898

THE EXPERIMENTAL MODIFICATION OF LAKE-EFFECT WEATHER,
Cornell Aeronautical Lab., Inc. Buffalo, N.Y.
William J. Eadie.
Available from NTIS as COM-71-00009, $3.00 in paper copy, $0.95 in microfiche. Final report, CAL Report No VC-2898-P-1, Aug 1970. 88 p, 8 fig, 6 tab, 16 ref. ESSA Contract No E 22-6-69 (N).
Identifiers: *Weather modification, *Great Lakes, *Snow fall, Reduction, Cloud seeding, Snowstorms, Intensity, Silver iodide, Ice, Meteorological radar, Radar echo areas, Dry ice, Mathematical models, Lake Erie, *Lake effect snowstorms.

During November and December of 1968, field experiments were carried out on the southeastern shore of Lake Erie to determine the feasibility of modifying lake-effect weather. The primary objective of the experiments was to test the hypothesis that the snowfall from intense lake-effect storms could be redistributed over a larger area by overseeding with ice nuclei, thereby reducing the heavy natural snowfall near the lee shore. The experiments demonstrated that overseeding can be accomplished for short periods in lake-effect snow bands of moderate intensity.
W71-04951

PROJECT SKYWATER, PROCEEDINGS: SKYWATER CONFERENCE IV OPTIMIZATION OF OPERATIONAL WEATHER MODIFICATION.
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.
For primary bibliographic entry see Field 03B.
W71-04956

A RARE EVENT OF INTENSE RAINFALL,
Bell Telephone Labs., Inc., Holmdel, N.J. Crawford Hill Lab.
R. A. Semplak.
Monthly Weather Review, Vol 99, No 2, p 155-157, February 1971. 3 p, 5 fig, 5 ref.

Descriptors: *Rainfall, *New Jersey, *Rain gages, *Rainfall intensity, *Distribution patterns, Networks, Precipitation intensity, Depth-area-duration analysis, Runoff, Urbanization, Cities.
Identifiers: Holmdel (New Jersey).

Data are presented for the most intense storm observed during a 3-yr recording period (1967-1969) on the Crawford Hill rain gage network at Holmdel, N.J. Point rain rates in excess of 270 mm per hr (10.6 in per hr) were observed. A total of about 280 million gallons of water fell in a 15-min interval over an area of 32.3 sq km (12.5 sq mi). (Knapp-USGS)
W71-05060

1968 FLORIDA CUMULUS SEEDING EXPERIMENT: NUMERICAL MODEL RESULTS,
National Oceanic and Atmospheric Administration, Miami, Fla. Experimental Meteorology Lab.
For primary bibliographic entry see Field 03B.
W71-05061

A STUDY OF THE HYDROLOGY OF EASTERN NORTH AMERICA USING ATMOSPHERIC VAPOR FLUX DATA,
Environmental Science Services Administration, Princeton, N.J. Geophysical Fluid Dynamics Lab.
Eugene M. Rasmusson.
Monthly Weather Review, Vol 99, No 2, p 119-135, February 1971. 17 p, 19 fig, 14 tab, 30 ref.

Descriptors: *Synoptic analysis, *Water balance, Evapotranspiration, Rainfall, Runoff, Water storage, Droughts, Precipitation (Atmospheric), Climatology, Hydrology, Weather, Atmosphere, Climatic data, Meteorology.
Identifiers: Flux divergence, Atmosphere.

The atmospheric water vapor flux divergence and the water balance of Eastern North America were investigated, using data from the period May 1, 1958, to April 30, 1963. Mean monthly values of evapotranspiration and storage change were computed as residuals, using measured values of vapor flux divergence, precipitation, and streamflow. Computed values of evapotranspiration and storage change were compared with the climatological estimates of Thornthwaite Associates and Budyko. The Thornthwaite climatic water balance data appear to overestimate the difference between precipitation and evapotranspiration, during winter and underestimate it during summer. Budyko's values of evapotranspiration generally show a slightly smaller seasonal variation and appear to lead the values obtained from the atmospheric budget computations by around 0.5 to 1 mo. Flux divergence computations were made for the Gulf of Mexico and Caribbean Sea. Interannual variations in storage over the Eastern Region of North America were found to be comparable with the seasonal changes. The onset of the drought of the early and mid-1960s is clearly reflected in the computed storage values. Variations in mean monthly precipitation during winter are positively correlated with the strength of the northward flow of moisture across the Gulf Coast, but little or no relationship between these quantities appears to exist during summer. (Knapp-USGS)
W71-05062

ANOMOLY PATTERNS OF CLIMATE OVER THE WESTERN UNITED STATES, 1700-1930, DERIVED FROM PRINCIPAL COMPONENT ANALYSIS OF TREE-RING DATA,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
V. C. LaMarche, and H. C. Fritts.
Monthly Weather Review, Vol 99, No 2, p 138-142, February 1971. 5 p, 2 fig, 3 tab, 7 ref. ESSA Grants E88-67-G and E231-68-G, NASA Grant NGR 03-002-101.

Descriptors: *Dendrochronology, *Paleoclimatology, *Droughts, Climatology, Ecology, Forests, Paleohydrology, Trees, Plant growth, Water shortage, Statistical methods, Frequency analysis.
Identifiers: *Western U.S.

Major anomaly patterns of annual tree-ring growth in 'drought-sensitive' trees of the Western United States, 1931-1962, seem to reflect corresponding patterns in monthly precipitation amounts, which in turn may be related to circulation anomalies. The three most important anomaly patterns that dominated the 1931-1962 period were also prominent in the tree-growth data during the preceeding period 1700-1930. These patterns can thus be expected to maintain their importance during at least the immediate future. Time series of eigenvector amplitudes show how the relative importance of the anomaly patterns changes through time. These can be studied for properties lending possible forecasting value and may provide important insight into the past behavior of the atmospheric circulation over the Western United States. (Knapp-USGS)
W71-05063

A DYNAMICAL MODEL OF FOG,
Advanced Technology Labs, Inc., Jericho, N.Y.
Antonio Ferri, Paolo Baronti, and Sheldon Elzweig.
Available from NTIS as AD-714 625, $3.00 in paper copy, $0.95 in microfiche. Rept no. ATL-TR-159, Sep 70. 45 p, 12 fig, 6 ref. AF Contract F44620-70-C-0007.
Identifiers: *Fog, Mathematical models, Drops, Condensation, Evaporation, Heat transfer, Water vapor, Numerical analysis, Temperature profiles, Supersaturation.

A model is presented to explain why fogs can be maintained for extended periods of time. The model considers the fog as a dynamical system whereby droplets depletion through fall is balanced by a continuous process of evaporation and condensation. The controlling parameters of the process are the heat transfer from the ground and the level of turbulence. The equations describing the system are presented and solved. Numerical examples are given and compared with experimental data.
W71-05151

REGIONALITIES OF CLIMATIC VARIATIONS OF THE WORLD,
Tokyo Metropolitan Univ. (Japan). Faculty of Science.

Toshinari Ambe.
Japanese Journal of Geology and Geography, Vol 38, No 1, p 63-77, 1967. 12 fig, 1 tab, 9 ref.

Descriptors: *Arid lands, *Climatic zones, *Geographical regions, *Water balance, *Climatic data, Maps, Statistical analysis, Temperature, Climatology, Precipitation (Atmospheric), Evaporation, Temperature, Deserts, Foreign countries, United States, Mexico, Distribution patterns, Classification, Variability.
Identifiers: *Climatic transitional regions, *Climatic classification, *Climatic types, *Potential evapotranspiration, Global studies, Continents, Hemispheres, Transitional region, South America, Asia, Africa, Australia.

It is argued that most climatic classification systems suffer from the practice of defining climatic boundaries on the basis of long term yearly averages, and that unstable regions are therefore ignored. A 'transitional region' is an area where the climatic type alternates yearly in accordance with boundary variations. Since the climate of a transitional region is inherently unstable, water need planning for such a region must differ from that for humid or arid regions. Using data from the previous study on arid climate variability, the ranges of transitional regions of arid climates were determined for each continent (except parts of Asia where data are lacking). This was done by using an index of variability of arid climates depending upon the number of arid years and humid years between 1931-1960. Maps are presented for each continent. A global climatic map was then constructed with 3 climatic types--real arid regions, transitional regions and regions without an arid year. Excepting North Africa, real arid regions are not a large proportion of the area where arid years occur, and lie generally in the 15-35 deg. latitudinal zone. The transitional region occurs very widely, and in many cases should be considered as an independent region rather than as a mere boundary area. This is an important aspect as a geographical factor, and offers many problems concerning land use or agriculture. (Casey - Arizona)
W71-05199

2C. Snow, Ice, and Frost

ENERGY EXCHANGE AND LATE SEASON SNOWMELT IN A SMALL OPENING IN COLORADO SUBALPINE FOREST,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
David R. Dewalle, and James R. Meiman.
Water Resources Research, Vol 7, No 1, p 184-188, February 1971. 5 p, 1 fig, 3 tab, 7 ref.

Descriptors: *Snowmelt, *Colorado, *Solar radiation, Melting, Radiation, Snowpacks, Energy budget, Runoff forecasting, Forests, Albedo, Data collections.
Identifiers: Radiation (Net).

Two-day melt of a late lying snow patch in a small opening in Colorado subalpine forest was largely due to net radiation and sensible heat exchange. Net radiation supplied 54% and 62% of melt energy on June 19 and 20, 1968, respectively, whereas sensible heat exchange accounted for 49% of melt energy. Three percent of melt energy was lost by evaporation each day. (Knapp-USGS)
W71-04863

PASSIVE MICROWAVE MEASUREMENTS OF SNOW, SOILS, AND OCEANOGRAPHIC PHENOMENA,
Aerojet-General Corp., El Monte, Calif. Space Div.
For primary bibliographic entry see Field 07B.
W71-04942

MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT,
Washington State Univ., Pullman.
For primary bibliographic entry see Field 05B.
W71-05046

SOME RESULTS FROM A TIME-DEPENDENT THERMODYNAMIC MODEL OF SEA ICE,
Washington Univ., Seattle. Dept. of Atmospheric Sciences and; Washington Univ., Seattle. Geophysics Program.
Gary A. Maykut, and Norbert Untersteiner.
Journal of Geophysical Research, Vol 76, No 6, p 1550-1576, February 20, 1971. 26 p, 12 fig, 8 tab, 55 ref. ONR Contract N00014-67-A-0103-0007.

Descriptors: *Sea ice, *Energy budget, *Mathematical models, *Numerical analysis, Solar radiation, Currents (Water), Snow cover, Heat transfer, Melting, Freezing, Water temperature, Ablation, Salinity, Albedo, Thermodynamics, Diffusion.
Identifiers: Sea ice model.

A one-dimensional thermodynamic model of sea ice includes the effects of snow cover, ice salinity, and internal heating due to solar radiation. Surface-energy balances determine rates of ablation and accretion; diffusion equations govern heat transport within the ice and snow. The incoming radiative and turbulent fluxes, oceanic heat, flux, ice salinity, snow accumulation, and surface albedo are specified as functions of time. The model was applied to the central Arctic. Values predicted by the model for the average ice thickness (288 cm) amount of surface ablation (40 cm), and the temperature field all agree closely with field observations. Other results from the model indicate that, under present conditions, the ocean supplies 1 to 2 kcal/sq cm year to the ice; an additional 4 kcal/sq cm year would cause the ice to vanish. Annual snow depths less than 70 cm would result in much thicker ice. About 2.0 to 2.5 kcal/sq cm year of the incoming short-wave radiation penetrates the ice and contributes to internal heating. Average ice albedos under 0.50 would cause the ice to vanish in a few years. (Knapp-USGS)
W71-05054

DESCRIPTION AND EVOLUTION OF SNOW AND ICE FEATURES AND SNOW SURFACE FORMS ON THE KASKAWULSH GLACIER,
Vermont Univ., Burlington. Dept. of Geology.
W. Philip Wagner.
In: Icefield Ranges Research Project Scientific Results, Volume 1: American Geographical Society (New York) and Arctic Institute of North America (Montreal), p 51-53, 1969. 3 p, 1 fig, 5 ref.

Descriptors: *Glaciers, *Regimen, *Diagenesis, *Snowmelt, *Ablation, Snowpacks, Seasonal, Geomorphology, Water balance, Ice, Snow, Movement, Climates, Weather, Stratigraphy.
Identifiers: Icefield Ranges (Canada), Snowfields.

Investigations of numerous snow pits on the Kaskawulsh Glacier suggested that the 1963 summer could be viewed in terms of a threefold, sequential development of surface and subsurface features related to snowmelt. Stage 1 was characterized by thin ice layers and rounded, medium-grained snow immediately underlying a non-descript snow surface. Stage 2 began on July 1 with a pronounced warm spell. Features characteristic of Stage 2 included surface depressions, ice and slush glands, 'slush columns', and 'slush walls'. Lateral expansion of surface depressions and related subsurface features occurred during Stage 2. By July 21, growth of surface depressions resulted in a snow surface with conspicuous mounds (distinctive for Stage 3), remnants of the inter-depression areas of Stage 2. Stages 1 and 3 began and ended when melt began in the spring and ended in the fall, respectively; the dates of these stages are unknown. (Knapp-USGS)
W71-05097

SNOW FACIES AND STRATIGRAPHY ON THE KASKAWULSH GLACIER,
Vermont Univ., Burlington. Dept. of Geology.
W. Philip Wagner.
In: Icefield Ranges Research Project Scientific Results, Volume 1: American Geographical Society (New York) and Arctic Institute of North America (Montreal), p 55-62, 1969. 8 p, 7 fig, 5 tab, 4 ref.

Descriptors: *Glaciers, *Regimen, *Diagenesis, *Snowmelt, *Ablation, Snowpacks, Seasonal, Geomorphology, Water balance, Ice, Snow, Movement, Climates, Weather, Stratigraphy.
Identifiers: Icefield Ranges (Canada), Snowfields.

Measurements of snow temperature, density, hardness, accumulation, and stratigraphy were made during the 1963 melt season in the accumulation zone of the north and central arms of the Kaskawulsh Glacier, Yukon Territory, Canada. The ablation facies extended from the glacier terminus at 810 m to the firn line at 1990 m. Temperature, hardness, and stratigraphic relationships located the saturation line, which separates wetted and percolation facies, between 2330 m and 2420 m. Significant melt occurred everywhere on the glacier; hence the dry snow facies was precluded. In contrast, the variation of density with altitude, which was found to be gradational across the saturation line, as defined by temperature, hardness, and stratigraphic data, suggests that only one facies (the wetted facies) occurred everywhere in the accumulation zone. However, because density is not thought to be a useful parameter for separating wetted and percolation facies on the Kaskawulsh Glacier, the density data are rejected as a primary parameter. It is concluded on the basis of temperature, hardness, and stratigraphy that both wetted and percolation facies were present. Thus the Kaskawulsh Glacier was subpolar in 1963. (Knapp-USGS)
W71-05098

O-18/O-16 RATIOS IN SNOW AND ICE OF THE HUBBARD AND KASKAWULSH GLACIERS,
Calgary Univ. (Alberta). Dept. of Geology; and Calgary Univ. (Alberta). Dept. of Physics.
D. S. Macpherson, and H. R. Krouse.
In: Icefield Ranges Research Project Scientific Results, Volume 1: American Geographical Society (New York) and Arctic Institute of North America (Montreal), p 63-73, 1969. 11 p, 12 fig, 10 tab, 25 ref.

Descriptors: *Stable isotopes, *Oxygen, *Glaciers, *Regimen, *Water balance, Water sources, Climates, Winds, Precipitation (Atmospheric), Tracers, Distribution patterns, Weather patterns.
Identifiers: *Oxygen isotopes, Icefield Ranges (Canada).

One hundred samples collected from the Hubbard and Kaskawulsh Glaciers in the St. Elias Mountains during the summer of 1963 were analyzed for O-18 and O-16. The delta O-18 values ranged from -18 to -29, with an average of about -23. Pits that were studied before extensive melting showed definite trends in delta O-18 with the more negative values corresponding to winter precipitation. Pits studied later in the season had the seasonal trend masked by the action of downward percolating meltwaters. The average of all pits and boreholes studied above the firn line gave no indication of an altitude variation of delta O-18 larger than the sampling error. A longitudinal profile below the firn line showed much scatter in the value, but the average trend was a decrease in going down-glacier from the firn line to the terminus. A transverse profile below the firn line which sampled three main ice streams gave remarkably consistent values near the margins, whereas the stream centers had decidedly more positive or negative values. These results are considered in terms of accepted modes of glacier flow. Precipitation studies exhibited much scatter and did not show the expected altitude variation. Much of the precipitation in the area is derived from the Pacific Ocean rather than from inland sources. (Knapp-USGS)
W71-05099

HIGH SNOWFIELDS OF THE ST. ELIAS MOUNTAINS,
Cold Regions Research and Engineering Lab., Hanover, N. H.

Edward Grew, and Malcolm Mellor.
In: Icefield Ranges Research Project Scientific Results, Volume 1: American Geographical Society (New York) and Arctic Institute of North America (Montreal), p 75-87, 1969. 13 p, 10 fig, 1 tab, 18 ref.

Descriptors: *Snowpacks, *Solar radiation, *Profiles, Water balance, Stratigraphy, Albedo, Glaciers, Density stratification, Snow cover, Snow surveys, Snowmelt, Infiltration.
Identifiers: *St. Elias Mountains (Canada).

Observations made during the 1964 summer provide a description of snow and radiation characteristics for the St. Elias Mountains and give insight into effects of altitude when anomalous wind and slope effects are excluded. Divide Camp, Seward Camp, and Lucania Camp were occupied successively within a minimum period of time to compare conditions at different altitudes. Data are presented on snow profiles, snow accumulation measurements, the development of the annual snow layer, snow conditions at depth, the mechanical properties of the snow, snow densification, solar radiation, and the variation of snow properties with surface altitude. It is concluded that as long as local anomalies are avoided, the effects of surface altitude on snow properties and surface processes seem to be simple. In Mountain regions it is usually a combination of local conditions which produces the effects. (Knapp-USGS)
W71-05100

MORPHOLOGY OF THE SLIMS RIVER,
New York State Univ. College, Fredonia.
For primary bibliographic entry see Field 02J.
W71-05101

ICEFIELD RANGES RESEARCH PROJECT SCIENTIFIC RESULTS, VOLUME 1,
American Geographical Society, New York, and Arctic Inst. of North America, Montreal (Quebec).
Vivian C. Bushnell, and Richard H. Ragle.
American Geographical Society (New York) and Arctic Institute of North America (Montreal), 1969. 224 p.

Descriptors: *Glaciers, Mountains, Climatology, Meteorology, Hydrology, Hydrogeology, Topography, Geomorphology, Limnology, Stratigraphy, Ecology, Projects, Grants, Arctic, Cold regions, Subarctic.
Identifiers: *Snowfields, St. Elias Mountains, Icefield Ranges (Canada), Geography.

The Icefield Ranges Research Project, under the institutional sponsorship of the Arctic Institute of North America and the American Geographical Society, seeks understanding of the natural environment of the St. Elias Mountains of Alaska and Yukon Territory. The project is multidisciplinary in its areas of research, and it is also interdisciplinary in its approach to its objectives. The Icefield Ranges Research Project has now completed eight field seasons, and the contents of this volume are representative of field work performed during the first four, from 1961 to 1965. (Knapp-USGS)
W71-05103

THE CHENA RIVER, THE STUDY OF A SUBARCTIC STREAM,
Federal Water Quality Administration, College, Alaska. Alaska Water Lab.
For primary bibliographic entry see Field 05B.
W71-05143

GREAT LAKES SNOWSTORMS. PART 1. CLOUD PHYSICS ASPECTS,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
James E. Jiusto, and Edmond W. Holroyd, III.
Available from NTIS as COM-71-00012, $3.00 in paper copy, $0.95 in microfiche. Jun 70. 153 p, 42 fig, 13 tab, 71 ref. ESSA Grant No E22-49-70 (G).

Identifiers: *Cloud seeding, *Great Lakes, *Snowstorms, Reduction, Cloud physics, Silver iodide, Aerosols, Freezing, Condensation nuclei, Atmospheric physics, Temperature, Meteorological radar, Dry ice, Snow fall, Radar cross sections, Networks, Mathematical models, Computer programs, Lake Erie, Lake Ontario, *Lake effect snowstorms.

Studies of the synoptic, mesoscale, and microphysical characteristics of snowstorms occurring to the lee of Lakes Erie and Ontario were done, with emphasis on defining precipitation mechanisms, land structure, aerosol characteristics and snowfall patterns. Cloud seeding was performed with silver iodide and with dry ice. The practical implications of each modification concept cannot be definitely assessed, but seeding with additional freezing nuclei to increase ground or lake precipitation can be accomplished, and seeding from the ground offers experimental and operational advantages. Snow crystal concentration at ground level is an effective measure of modification efficacy. It is recommended that the ground observer network be increased by a factor of 3, and that the duration and area of seeding be increased by at least a factor of 2 to 3.
W71-05153

APPLICATION OF METHOD FOR PREDICTING THERMAL ERROR IN MEASUREMENT OF GROUND TEMPERATURE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
Warren M. Rohsenow.
Available from NTIS as AD-818 015, $3.00 in paper copy, $0.95 in microfiche. Cold Regions Research and Engineering Lab Technical Report 186, May 1967. 6 p, 8 fig, 1 tab, 1 ref. Army Corp of Eng Contract DA-19-016-ENG-3204.
Identifiers: *Terrain, Surface temperatures, Instrumentation, Probes, Predictions, Errors, Atmospheric temperature, Heat transfer, Measurement, Snow, Ice, Permafrost, Soils.

The use is illustrated of generalized charts in estimating the thermal error in measurement of ground temperature in the case of a probe inserted in a pit wall. The word 'ground' includes snow and ice as well as soil materials. Two major sources of error, other than instrument error, are inherent in this type of measurement. If the air temperature differs from the ground temperature, heat will be exchanged between the air and side walls of the excavation as soon as the pit is opened. The ground temperature must be read before appreciable heat transfer occurs. A second error is introduced upon insertion of the temperature sensing element if the element temperature differs from the ground temperature.
W71-05257

LOW-TEMPERATURE PHASES OF INTERFACIAL WATER IN CLAY-WATERS SYSTEMS,
Cold Regions Research and Engineering Lab., Hanover, N.H.
Duwayne M. Anderson, and Allen R. Tice.
Available from NTIS as AD-715 714, $3.00 in paper copy, $0.95 in microfiche. Research Report 290, Oct 1970. 15 p, 3 fig, 2 tab, 19 ref.
Identifiers: *Clay minerals, Water, *Arctic regions, Construction, Thermal analysis, Interfaces, Frost heave, Freezing, Phase studies, Ice, *Clay water systems, Frozen soils, *Interfacial water.

Low temperature differential thermal analyses of selected clay-water systems were made to locate important phase change temperatures and to define fruitful temperature-pressure fields for precise calorimetric investigation. In addition to an exotherm corresponding to initial freezing, one, two or three exotherms were observed between -35 C and-60 C. The low temperature exotherms do not depend critically upon water content, but clearly they are related to clay mineral and exchangeable cation type. The evolution of heat in this temperature range probably corresponds to a phase change in the interfacial water.
W71-05258

THE TEMPERATURE STRUCTURE OF A MID-LATITUDE, DIMICTIC LAKE DURING FREEZING, ICE COVER, AND THAWING,
Cold Regions Research and Engineering Lab., Hanover, N.H.
For primary bibliographic entry see Field 02H.
W71-05259

2D. Evaporation and Transpiration

A COMPARISON OF ENERGY BALANCE METHODS FOR ESTIMATING ATMOSPHERIC THERMAL RADIATION,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Keith R. Cooley, and Sherwood B. Idso.
Water Resources Research, Vol 7, No 1, p 39-45, February 1971. 7 p, 3 fig, 2 tab, 18 ref.

Descriptors: *Solar radiation, *Energy budget, *Evapotranspiration, Heat budget, Cloud cover, Evaporation, Hydrologic cycle, Transpiration, Measurement, Data collections, Data processing.
Identifiers: *Radiation balance.

A radiation balance method and a modified radiation balance method were used to determine hourly and daily values of atmospheric thermal radiation on three clear and three cloudy days during February and March 1970 at Phoenix, Arizona. The radiation balance was used over surfaces of bare soil, Bermuda gross, and open water; the modified radiation balance was used over the open water surface only. The modified radiation balance differed from the pure radiation balance method in that net radiation was calculated as the residual in the energy equation rather than measured. The values of atmospheric thermal radiation thus obtained were compared to values obtained from measurements of incoming, all-wave radiation minus incoming solar radiation. The best alternative to the semi-direct measurement of atmospheric thermal radiation was the radiation balance over the bare soil surface. Results from this method were of sufficient accuracy, even on an hourly basis, for most research studies, and were even better on a daily basis. Radiation balances over grass and water surfaces were somewhat less satisfactory, but still better than the modified radiation balance method. (Knapp-USGS)
W71-04852

SOME OBSERVATIONS ON THE EFFECT OF WIND INDUCED THERMAL MIXING,
Saskatchewan Research Council, Saskatoon.
G. Lakshman.
Water Resources Research, Vol 7, No 1, p 189-194, February 1971. 6 p, 8 fig, 2 ref.

Descriptors: *Evaporation, *Lakes, *Mixing, *Winds, *Thermal stratification, Energy budget, Water temperature, Radiation, Solar radiation, Mass transfer, Convection, Advection, Ponds.
Identifiers: Saskatchewan.

Wind induced thermal mixing in a pond or slough influences the diurnal variation in the water surface temperature. This, in turn, greatly affects the rate of evaporation from the water surface. The maximum diurnal rise in the water temperature depends on the total duration of sunshine, the maximum rise in air temperature above the initial water temperature, and the wind speed. Sheltering a pond may increase the rate of evaporation under certain conditions. (Knapp-USGS)
W71-04864

EVAPORATION LOSSES IN SPRINKLER IRRIGATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering; and Florida Univ., Gainsville. Water Resources Research Center.
J. M. Myers, C. D. Baird, and R. E. Choate.

Available from NTIS as PB-197 735, $3.00 in paper copy, $0.95 in microfiche. Florida Water Resources Research Center, Publication No 12, December 31, 1970. 41 p, 1 tab, 17 fig, 34 ref. OWRR Project A-003-FLA (2).

Descriptors: *Irrigation, *Evaporation, Wind velocity, Water temperature, Dew point, Air temperature, *Rates of application, Interception, Irrigation efficiency, *Sprinkler irrigation, Florida.
Identifiers: Evaporation loss.

Water conservation, distribution of chemicals through irrigation water and the increasing popularity of low application rate irrigation systems are all important factors pointing up the need for more precision in irrigation management which in turn is dependent upon accurate estimates of expected evaporation losses. Data has been obtained to predict the independent effect of water application rate, air (wind) velocity, water temperature and dry bulb and dew point temperature of the ambient air on evaporation losses by water droplets and water droplets in combination with plant intercepted water. By far the most influential factor on evaporation losses is the rate of application. Results indicate evaporation losses are about 60% for low application rates (0.15 iph) with climatic conditions typical of Florida and when plant foliage is present to intercept most of the applied water.
W71-04938

A STUDY OF THE HYDROLOGY OF EASTERN NORTH AMERICA USING ATMOSPHERIC VAPOR FLUX DATA,
Environmental Science Services Administration, Princeton, N.J. Geophysical Fluid Dynamics Lab.
For primary bibliographic entry see Field 02B.
W71-05062

TESTS OF SOLAR RADIATION MODELS IN THREE FOREST CANOPIES,
San Diego State Coll., Calif. Dept. of Biology.
P. C. Miller.
Ecology, Vol 50, No 5, p 878-885, 1969. 2 fig, 4 tab, 12 ref.

Descriptors: *Solar radiation, *Mathematical models, Forecasting, Photosynthesis, Primary productivity, Evaporation.
Identifiers: *Forest canopies, Leaf area.

Several models expressing the decrease of solar radiation in vegetation canopies have been proposed. The models are similar in (1) including a method of projecting the shadow of one or more leaves into a horizontal plane and (2) including a method of relating the projected shadow to the decrease of solar radiation. The models differ in the equations used and in the assumptions made. The models use the binomial, the Poisson, or some modification of the binomial to relate the projected shadow to the radiation at different levels. When the models were tested against the percentage of sunlit area at different levels in the canopy, the best fitting model was one proposed in this paper in which the shadow of the leaf is projected as a shadow of a cone and the binomial is used to express the decrease of radiation. Negative exponential models usually overestimated the percentage of sun. Including the shadow cast by twigs and branches in the prediction improved the agreement between the observed and the expected percentage of sun. Primary production models in which the negative exponential is used to calculate solar radiation may overestimate the actual production. (Upadhyaya-Vanderbilt)
W71-05131

EVAPORATION REDUCTION WITH FLOATING GRANULAR MATERIALS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 03B.
W71-05138

A DYNAMICAL MODEL OF FOG,
Advanced Technology Labs, Inc., Jericho, N.Y.
For primary bibliographic entry see Field 02B.
W71-05151

2E. Streamflow and Runoff

ANALYSIS OF THE USE OF DISTORTED HYDRAULIC MODELS FOR DISPERSION STUDIES,
California Univ., Berkeley. Dept. of Civil Engineering; and Illinois Univ., Urbana. Dept. of Civil Engineering.
Hugo B. Fischer, and E. R. Holley.
Water Resources Research, Vol 7, No 1, p 46-51, February 1971. 6 p, 3 fig, 8 ref.

Descriptors: *Hydraulic models, *Hydraulic similitude, *Dispersion, *Mixing, *Waste dilution, Steady flow, Unsteady flow, Path of pollutants, Lakes, Rivers, Estuaries, Model studies.
Identifiers: Distorted hydraulic models.

The model ratios applicable to dispersion studies in distorted hydraulic models are investigated for both steady and oscillatory flow, and the effects of both vertical and transverse distributions of velocity on the dispersion process are considered. It is shown that simple transposition of concentration profiles from model to prototype is not valid and that models may magnify or reduce longitudinal dispersion depending on the geometry of the system. For that reason, physical models are unlikely to be useful for studies of pollutant dispersion. (Knapp-USGS)
W71-04853

NUMERICAL SIMULATION OF FLOOD WAVE MODIFICATION DUE TO BANK STORAGE EFFECTS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W71-04854

A COMPARATIVE STUDY OF CRITICAL DROUGHT SIMULATION,
California Univ., Los Angeles. Dept. of Engineering Systems.
For primary bibliographic entry see Field 04A.
W71-04861

LAW OF STREAM RELIEF IN HORTON'S STREAM MORPHOLOGICAL SYSTEM,
Hawaii Univ., Honolulu. Water Resources Research Center.
Yu-Si Fok.
Water Resources Research, Vol 7, No 1, p 201-203, February 1971. 3 p, 1 tab, 5 ref.

Descriptors: *Topography, *Geomorphology, *Drainage patterns (Geologic), Statistical methods, Elevation, Erosion, Mapping, Shape, Slopes, Valleys, Mathematical studies.
Identifiers: Stream order.

Within a river basin, the streams can be classified by the Horton-Strahler stream order system. The average stream lengths and slopes are semilogarithmic functions of the stream order. In this study, paralleling Horton's development, the law of stream relief is proposed and the average stream relief is found also to be a semilog function of the stream order. The riverbed profile can be described by a semilog equation expressing stream relief as a function of stream length. The F value in the stream relief equation may be considered as an indicator of the riverbed profile properties. (Knapp-USGS)
W71-04866

FLOOD ROUTING THROUGH STORM DRAINS: PART I. SOLUTION OF PROBLEMS OF UNSTEADY FREE SURFACE FLOW IN STORM DRAINS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W71-04890

FLOOD ROUTING THROUGH STORM DRAINS: PART II. PHYSICAL FACILITIES AND EXPERIMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W71-04891

FLOOD ROUTING THROUGH STORM DRAINS: PART III. EVALUATION OF GEOMETRIC AND HYDRAULIC PARAMETERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W71-04892

PROGRAM OF THE WATER RESOURCES DIVISION, TEXAS DISTRICT, FOR THE 1971 FISCAL YEAR AND SUMMARY OF DISTRICT ACTIVITIES DURING FISCAL YEAR 1970.
Geological Survey, Austin, Tex. Water Resources Div.
For primary bibliographic entry see Field 07C.
W71-04906

WILD RIVERS -- METHODS FOR EVALUATION,
Water Resources Engineers, Inc., Walnut Creek, Calif.
For primary bibliographic entry see Field 06B.
W71-04930

STORM RUNOFF RESPONSE FROM ROAD-BUILDING AND LOGGING ON SMALL WATERSHEDS IN THE OREGON COAST RANGE,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04C.
W71-04968

A METHOD FOR RELATING INFILTRATION RATES TO STREAMFLOW RATES IN PERCHED STREAMS,
Geological Survey, Tucson, Ariz.
For primary bibliographic entry see Field 02F.
W71-04971

SYNTHESIZING HYDROGRAPHS FOR SMALL SEMIARID DRAINAGE BASINS,
Geological Survey, Cheyenne, Wyo.
For primary bibliographic entry see Field 02A.
W71-04972

THE EFFECT OF STREAM DISCHARGE ON STREAMBED LEAKAGE TO A GLACIAL OUTWASH AQUIFER,
Geological Survey, Columbus, Ohio.
For primary bibliographic entry see Field 02F.
W71-04973

EVALUATION OF THE STREAMFLOW DATA PROGRAM FOR ARKANSAS,
Geological Survey, Little Rock, Ark.
For primary bibliographic entry see Field 07C.
W71-04974

WATER RESOURCES OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE AND NORTH CAROLINA,
Geological Survey, Washington, D.C.
W. M. McMaster, and E. F. Hubbard.

For sale by US Geological Survey, Washington, DC 20402 - Price $1.50, per set. Geological Survey Hydrologic Investigations Atlas HA-420, 2 sheets, 1970. Text, 13 fig, 2 map, 5 tab, 15 ref.

Descriptors: *Water resources, *Surveys, *Hydrologic data, *Tennessee, *North Carolina, Water resources development, National parks, Hydrogeology, Streamflow, Topography, Water supply, Water yield, Water wells, Water quality.
Identifiers: *Great Smoky Mountains National Park.

The Great Smoky Mountains National Park is located on the Tennessee-North Carolina border in the southern part of the Appalachian Range. In order to plan effectively for the development of new facilities, and the management of the park's resources, the Park Service needs information on how much water is available at different places in the park. This 2-sheet hydrological atlas is intended to satisfy that need. Sheet 1 covers the surface-water resources in the park and sheet 2 the ground-water resources. Emphasis was placed on evaluating the occurrence, availability, and quality of groundwater. An important part of the study is the flow of streams, particularly low flows. Low flows are a limiting factor when developing a stream for water supply. Low-flow data are also essential in stream-pollution studies and for the protection of aquatic life and resident environment. Many recreational uses of the streams also depend on adequate low flows. The park is located in one of the wettest regions of the United States. Precipitation in the park as a whole averages 64 inches annually. Average discharge ranges from less than 2 to more than 4 cfsm. The low flows of the streams are more variable than the average flows. Seven-day, 2-year minimum flows range from less than 0.1 to more than 0.8 cfsm. Availability of groundwater and surface water is shown by maps. Other hydrologic data are summarized in hydrographs, duration curves, graphs, charts, and tables. (Knapp-USGS)
W71-04979

FLOOD OF MARCH 1968 ON THE SUDBURY, ASSABET, AND CONCORD RIVERS, MASSACHUSETTS,
Geological Survey, Washington, D.C.
R. G. Petersen, G. K. Wood, and R. A. Gadoury.
For sale by US Geological Survey, Washington, DC 20402 - Price $1.25 per set. Geological Survey Hydrologic Investigations Atlas HA-371, 2 sheets, 1970. Text, 3 fig, 3 photo, 2 tab, 6 ref.

Descriptors: *Floods, *Massachusetts, *Antecedent precipitation, *Snowmelt, Rainfall-runoff relationships, Surface-groundwater relationships, Hydrologic data, Overflow, Storm runoff, Precipitation (Atmospheric), Flood damage.
Identifiers: *Sudbury River (Mass), *Assabet River (Mass), *Concord River (Mass), *Concord (Mass).

The areas flooded by the Sudbury, Assabet, and Concord Rivers, Massachusetts, in March 1968 are shown by a 2-sheet hydrologic atlas consisting of maps, tables, frequency graphs, hydrographs, and text. During a 3-day period from March 17 to 19, 1968, a total of 3 to 7 inches of rain fell on parts of eastern Massachusetts. This heavy rainfall, combined with the generally wet antecedent conditions of the spring season and some runoff from snowmelt, caused considerable flooding of the rivers in the area. The purpose of this report is to show flood stages and areas inundated by the March 1968 flood, to compare the severity of this flood with past floods, and to show the frequency of floods of given magnitudes which may be expected in the future at gaging stations in the basins. (Knapp-USGS)
W71-04980

FLOOD OF JUNE 1967 AT GRAND ISLAND, NEBRASKA,
Geological Survey, Washington, D.C.
F. Butler Shaffer, and Kenneth J. Braun.
For sale by US Geological Survey, Washington, DC 20402 - Price $0.75. Geological Survey Hydrologic Investigations Atlas HA-352, 1 sheet, 1970. Text, 2 fig, 2 photo, 2 map.

Descriptors: *Floods, *Nebraska, *Antecedent precipitation, Rainfall-runoff relationships, Surface-groundwater relationships, Hydrologic data, Overflow, Storm runoff, Precipitation (Atmospheric), Flood damage.
Identifiers: *Grand Island (Nebr).

Flooding in 1967 at Grand Island, Nebraska is shown by a 1-sheet hydrological atlas consisting of a map of the flooded area, profiles, and text. Rain on June 13-15, 1967, was the immediate cause of widespread flooding in northeastern Hall and western Merrick Counties, Nebr. The inundated areas included parts of the city of Grand Island, (population, 30,675), part of the Cornhusker Ordnance Plant, and extensive tracts of rich agricultural land. The Abbott and Grand Island quadrangles lie almost wholly on the broad, nearly flat floor of the Platte River valley. The flooding occurred in the drainage basins of Wood River, Warm Slough, and Prairie Creek, each of which is tributary to the Platte River downstream from the map area. During the period May 26 to June 12, a succession of rains totaling 7 to 10 1/2 inches fell in the area. Most of the precipitation was absorbed by the terrain. On the thoroughly soaked grounds, 2 to more than 6 inches of rain fell on June 13-15. Extensive flooding was the result. North Channel and Wood River are incised less than 5 feet below the land surface. Because the antecedent precipitation had raised the water table to or above their channel floors, runoff from the additional rain soon had both streams overflowing. (Knapp-USGS)
W71-04981

SIMULATION THEORY APPLIED TO WATER RESOURCES MANAGEMENT,
Nevada Univ., Reno. Center for Water Resources Research.
For primary bibliographic entry see Field 06A.
W71-05042

ANALYSIS OF WATER TEMPERATURE VARIATIONS IN LARGE RIVER,
Illinois State Water Survey, Peoria.
For primary bibliographic entry see Field 02K.
W71-05048

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR MOUNTAIN CREEK, TRINITY RIVER BASIN, TEXAS, 1969,
Geological Survey, Austin, Tex. Water Resources Div.
For primary bibliographic entry see Field 07C.
W71-05049

THE BREAKING OF WATER WAVES,
Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.
Roland K. Price.
Journal of Geophysical Research, Vol 76, No 6, p 1576-1581, February 20, 1971. 6 p, 2 fig, 10 ref. NSF Grant GA 1187 ONR Grant 1467-0103-0020.

Descriptors: *Waves (Water), *Surf, Currents (Water), Flow, Hydraulics, Ocean waves, Shores, Beaches.
Identifiers: *Corner flow.

A steady progressive wave of maximum amplitude can be defined as a wave that has a corner flow at its crest. An analytical examination of the response of such a corner flow to certain perturbations gives a realistic description of the breaking of a spilling breaker. In particular it is shown that breaking will occur in the direction of propagation of the wave. (Knapp-USGS)
W71-05055

BOTTOM DRIFT FOR THE SOLITARY WAVE,
Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.
For primary bibliographic entry see Field 02J.
W71-05056

EXPERIMENTAL FLUME INVESTIGATION OF HYDRAULIC TRANSIENTS IN RIVER-RESERVOIR SYSTEMS,
Tennessee Univ., Knoxville.
Milind S. Bhargave.
M Sc Thesis, Tennessee University Graduate School, December 1969. 43 p, 13 fig, 6 tab, 11 ref. OWRR Project B-005-TENN (2).

Descriptors: *Unsteady flow, *Model studies, *Flumes, *Hydraulic transients, *Rivers, Flow characteristics, Reservoir, Test procedures, Research equipment, Methodology, Computer programs, Mathematical models, Equations, Streamflow, Waves (Water), Velocity, Time, Stage-discharge relations, Hydraulic models, Hydraulic similitude.
Identifiers: Flood waves.

Since 1966 the Tennessee Valley Authority has been using a one-dimensional mathematical model, known as the 'Simulation of Open Channel Hydraulics,' to solve the basic equations of unsteady flows in reservoirs and rivers. The validity of this model in describing wave motion in an open channel was studied. A 62-foot-long, 1 foot by 1 foot, cross-sectional plexiglas flume was built to perform the experiments. The computer program output which predicts temporal and spatial variations in water surface elevations and mean velocities was compared to experimental water surface elevations and mean velocities. Transient wave motions were created by time-varying discharges at the upstream and downstream ends. The experimental results compared satisfactorily with those obtained by using the mathematical model. (Woodard-USGS)
W71-05087

THE STREAMFLOW DATA PROGRAM IN IOWA - EVALUATION OF THE PAST, PROPOSAL FOR THE FUTURE,
Geological Survey, Iowa City, Iowa.
For primary bibliographic entry see Field 07C.
W71-05093

MORPHOLOGY OF THE SLIMS RIVER,
New York State Univ. College, Fredonia.
For primary bibliographic entry see Field 02J.
W71-05101

ICEFIELD RANGES RESEARCH PROJECT SCIENTIFIC RESULTS, VOLUME 1,
American Geographical Society, New York, and Arctic Inst. of North America, Montreal (Quebec).
For primary bibliographic entry see Field 02C.
W71-05103

OCEANIC HEAT CONTENT OFF OREGON: ITS VARIATIONS AND THEIR CAUSES,
Oregon State Univ., Corvallis. Dept. of Oceanography.
James G. Pattullo, Wayne V. Burt, and Sally A. Kulm.
Limnology and Oceanography, Vol 14, No 2, p 279-287, March 1969. 9 p, 4 fig, 3 tab, 5 ref. NSF Grant GP-5165; ONR Research Contract Nonr 1286 (10).

Descriptors: *Water temperature, *Bathythermographs, *Sea water, *Oregon, Variability, Ocean currents, Currents (Water), Water circulation, Oceanography, Statistical methods, Sampling, Data collections.

Heat control, surface to 100 m, was computed for oceanographic stations within 165 nautical miles of the Oregon coast. Mean content, 1962 through

1965, was 100 kg cal per sq m, with a root mean square deviation of 13 kg cal per sq cm. The principal fluctuation around the mean was seasonal; the seasonal range among monthly mean values was twice as large offshore, beyond 100 miles from the coast (35 kg cal per sq cm) as the range inshore, within 65 miles of shore (15 kg cal per sq cm). The cause of the seasonal variation offshore was local heating, but advection was important inshore. Observed ranges in heat storage inshore were only a third as large as expected from the computed local heating. The results are consistent with inshore currents from the south in winter and coastal upwelling associated with offshore transport of water and heat in summer. Inshore the seasonal regime was not dominant; fluctuations of long and short periods and geographical variations were also appreciable. (Knapp-USGS)
W71-05105

WATER RESOURCES AND GEOLOGY OF GLOUCESTER COUNTY, NEW JERSEY,
Geological Survey, Trenton, N.J.
For primary bibliographic entry see Field 02F.
W71-05110

SOME CHARACTERISTICS OF THE THERMAL REGIME OF RIVERS IN THE DANUBE AND DNIESTER BASINS,
Ukrainskii Nauchno-Issledovatelskii Gidrometeorologicheskii Institut, Kiev (USSR).
N. G. Dyukel.
Soviet Hydrology, Selected Paper No 4, p 381-387, 1969. 4 fig, 4 tab, 5 ref.

Descriptors: *Groundwater recharge, *Water temperature, River basins, Elevation, Air temperature, Thermocline, Temperature, Water pollution sources.
Identifiers: *Thermal regime, *Danube river basin, *Dniester river basin.

The thermal regime of rivers in the Tissa, Seret, Prut, and Dniester basins is determined by climatic conditions and, primarily, by air temperature. After analysing extensive data it is concluded, that when generalizing the characteristics of the thermal regime, allowance must be made for the influence of local conditions, especially for strong groundwater recharge and human activity, which are frequently more important than climatic factors and actually determine the thermal regime in a given reach of a water course. For example, the thermal regime in a river reach with strong groundwater recharge is determined by the percentage and temperature of groundwater in the total flow. For rivers whose basin is located in the mountains or in piedmont areas, elevation is an integrating factor, determining their thermal regime in reaches with moderate groundwater recharge. (Upadhyaya-Vanderbilt)
W71-05141

STATISTICAL RELATIONSHIPS BETWEEN STORM AND URBAN WATERSHED CHARACTERISTICS,
Utah State Univ., Logan. Water Research Lab.
For primary bibliographic entry see Field 04A.
W71-05144

FLOOD PLAIN DELINEATION WITH PAN AND COLOR,
Wisconsin Univ., Madison. Department of Soil Science.
For primary bibliographic entry see Field 07B.
W71-05145

2F. Groundwater

POROSITY AND DISPERSION CONSTANT CALCULATIONS FOR A FRACTURED CARBONATE AQUIFER USING THE TWO WELL TRACER METHOD,
Geological Survey, Denver, Colo. Water Resources Div.
D. B. Grove, and W. A. Beetem.
Water Resources Research, Vol 7, No 1, p 128-134, February 1971. 7 p, 3 fig, 6 ref.

Descriptors: *Hydrogeology, *Carbonate rocks, *Fractures (Geology), *Tracers, Karst, Groundwater movement, Tracking techniques, Flow nets, Pumping, Withdrawal, Water wells, Aquifers, New Mexico, Limestones, Dispersion, Diffusion, Permeability, Porosity, Storage coefficient, Radioactivity techniques, Tritium.
Identifiers: *Aquifer tests, *Pumping tests.

The time concentration profile from the discharging well of a labeled recharging-discharging well pair is used to evaluate an aquifer's porosity and dispersion constant. The technique is applicable for pulse tracer injection and recirculation. Derived equations allow prediction of streamline arc lengths and travel times between wells along streamlines. Adjacent streamlines joining the two wells define volumes that approximate dispersion columns of known length. The summation of breakthrough curve concentration profiles for flow through these individual columns provides a composite breakthrough curve for the entire flow field. Analysis of a tracer test using tritium in a fractured carbonate aquifer near Carlsbad, New Mexico, provided a dispersion constant of 125 feet and a porosity of 12.0%, values consistent with known properties of the aquifer. (Knapp-USGS)
W71-04859

PERTURBATION SOLUTIONS OF THE DISPERSION EQUATION IN POROUS MEDIUMS,
Technion-Israel Inst. of Tech., Haifa.
Gedeon Dagan.
Water Resources Research, Vol 7, No 1, p 135-142, February 1971. 8 p, 3 fig, 18 ref.

Descriptors: *Dispersion, *Porous media, *Groundwater movement, Equations, Hydrogeology, Darcys law, Mathematical studies, Boundary layers, Flow nets, Flow, Velocity, Percolation, Steady flow, Tracers.
Identifiers: Dispersion equations.

The solution of the dispersion equation for porous media is difficult because of the dependence of the dispersion tensor on the velocity. Approximate solutions of dispersion in nonuniform two-dimensional flows are sought by perturbation expansions. An inner boundary layer solution for the transition zone between two fluids in steady and unsteady conditions is derived. Two examples of dispersion, radial flow and coastal aquifers, are solved approximately. (Knapp-USGS)
W71-04860

INFLUENCE CHART FOR REGIONAL PUMPING EFFECTS,
Hydrologic Commission of the Valle de Mexico Basin, Mexico City.
For primary bibliographic entry see Field 04B.
W71-04867

SINGLE-WELL TECHNIQUE USING P-32 FOR DETERMINING DIRECTION AND VELOCITY OF GROUNDWATER FLOW,
Middle Eastern Regional Radioisotope Center for the Arab Countries, Cairo, United Arab Republic.
I. B. Hazzaa.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/44, p 713-724, 1970. 12 p, 7 fig, 12 ref.

Descriptors: *Groundwater movement, *Tracers, *Tracking techniques, Radioactivity techniques, Radioisotopes, Phosphorus radioisotopes, Tagging, Flow, Boreholes, Water wells.
Identifiers: *Radiographic techniques.

A radiographic method for determining the direction and the velocity of groundwater flow was developed. The radioisotope P-32 is injected, as a point or a thin-column source, at the center of the well. The injection is performed at the desired depth without disturbing the water. The radioisotope is left to follow the horizontal flow of water. Some of the P-32 is adsorbed onto the walls of two parallel detecting screens which are separated by a few centimeters and fitted inside the well. Both the inner and outer screens are radiographed; the darkest parts of the emulsions and the north direction marked on another film give the flow direction. The blackening of each film in the screen is measured. Velocities are determined either by the displacement method or from the calibration curve of the velocity versus relative blackening. (Knapp-USGS)
W71-04878

METHOD OF DETERMINING LEAKAGE VELOCITIES THROUGH THE BOTTOM OF RESERVOIRS,
Institute of Nuclear Physics, Cracow, Poland.
For primary bibliographic entry see Field 04A.
W71-04880

COMPARISON OF HYDROLOGICAL AND MATHEMATICAL METHODS IN ANALYSIS OF TRITIUM DATA,
Federal Experimental and Research Institute Arsenal, Vienna, and Technical High School, Vienna, Austria.
For primary bibliographic entry see Field 07C.
W71-04881

CONTRIBUTION TO THE SELECTION OF RADIOACTIVE TRACERS FOR HYDROGEOLOGY (FRENCH),
Bureau of Geological and Mining Research (BRGM), Paris, France, and Commission of European Communities, Brussels, Belgium.
For primary bibliographic entry see Field 07B.
W71-04883

RADON IN GROUNDWATERS OF DOLOMITIC AND CALCAREOUS AQUIFER IN APULIA (SOUTHERN ITALY),
CNEN, Laboratory for the Application of Radioisotopes to Hydrogeology, Bari, and Bari Univ., Italy.
For primary bibliographic entry see Field 02K.
W71-04884

SILICON-32 HYDROLOGY,
Tata Inst. of Fundamental Research, Bombay, India.
For primary bibliographic entry see Field 02K.
W71-04885

A COMPUTER-ORIENTED GENERALIZED POROSITY-LITHOLOGY INTERPRETATION OF NEUTRON, DENSITY AND SONIC LOGS,
Gulf Research and Development Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 07C.
W71-04889

THE CENOMANIAN-TURONIAN CALCAREOUS AQUIFER OF CENTRAL AND WESTERN GALILEE, ISRAEL,
Geological Survey of Israel, Jerusalem.
U. Kafri.
International Association of Scientific Hydrology Bulletin, Vol 15, No 4, p 77-91, December 1970. 15 p, 7 fig, 3 tab, 31 ref.

Descriptors: *Aquifers, *Water circulation, *Karst, Recharge, Discharge (Water), Water balance, Water circulation, Springs, Permeability, Hydrogeology, Water chemistry, Water quality, Bicarbonates, Salinity, Groundwater movement.
Identifiers: *Israel.

The regional Cenomanian-Turonian aquifer of central and Western Galilee is devided into two partly connected subaquifers. The different rates of karstic erosion in the subaquifers depend on differences in lithology, initial porosity, degree of exposure and structural position. The springs of Western Galilee are natural outlets, some of them draining the lower subaquifer and some the upper one. Those that drain the upper subaquifer show a rapid decay and a good correlation with precipitation. Those of the lower subaquifer show a relatively slow decay and point to a large storage. Replenishment equations, as well as average replenishment estimates, were obtained for three out of five of the springs. The groundwaters of this area are generally of the bicarbonate type with low salinity, typical of an intake area. The salinity increases toward the base levels to the west and the south, where the waters become of the chloride type. In some places the high salinities could be related to the mixing of fresh water with small amounts of sea water. (Knapp-USGS)
W71-04900

MATHEMATICAL MANAGEMENT MODEL--UNCONFINED AQUIFER,
Texas Tech Univ., Lubbock. Water Resources Center; and High Plains Underground Water Conservation District No. 1, Lubbock, Tex.
Albert Sechrist, B. J. Claborn, Frank Rayner, and D. M. Wells.
Available from NTIS as PB-197 788, $3.00 in paper copy, $0.95 in microfiche. Final Report, October 31, 1970. 148 p, 7 tab, 23 fig, 4 append. OWRR Project C-1537 (NO 1993) (1).

Descriptors: *Groundwater, *Groundwater management, *Computer programs, *Recharge, *Model studies, *Mathematical models, Computer models, *Texas, *Aquifers, Aquifer characteristics, Wells, Withdrawal, Drawdown, *Consumptive use, Underground storage.
Identifiers: *Ogallala aquifer, Southern High Plains (Texas).

The numerical model for groundwater flow developed by the California Department of Water Resources (DWR) was adapted to a 2290 square mile region of the Ogallala Aquifer in the Southern High Plains of Texas. A computer program was written to define Theissen type polygons around each of 183 observation wells. Model verification was based on a five year period. Net withdrawals for this period were estimated from consumptive use calculations. The model is more sensitive to net withdrawal variations than to either permeability or storage coefficient variations. Constant values of aquifer properties and a six element consumptive use vector yielded an average error of 0.07 feet after five years, and a standard deviation of 9.1 feet. A recharge operation in one segment of the study area is used as an example of usefulness of the model. (Claborn-Texas Tech)
W71-04931

HYDROLOGIC AND PHOTOGEOLOGIC DETERMINATION OF RAINFALL, RUNOFF, AND GROUNDWATER RELATIONSHIPS IN A DOLOMITE AREA,
Missouri Water Resources Research Center, Rolla; and Missouri Water Resources Research Inst., Rolla.
For primary bibliographic entry see Field 02A.
W71-04937

THE PRE-QUATERNARY SURFACE IN THE JORDAN VALLEY, UTAH,
Geological Survey, Salt Lake City, Utah; and Geological Survey, Denver, Colo.
Ted Arnow, Richard Van Horn, and Reed LaPray.
For sale by Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D257-D261, 1970. 5 p, 1 fig, 8 ref.

Descriptors: *Aquifers, *Utah, Quaternary period, Alluvium, Groundwater, Water resources development, Stratigraphy, Limestones, Clays, Sands, Gravels, Water levels, Transmissivity, Logging (Recording), Subsurface investigations, Hydrogeology.
Identifiers: *Jordan Valley (Utah).

The altitude of the base of the Quaternary deposits in the Jordan Valley, Utah, was determined by interpretation of drillers' logs of water wells supplemented with some geological and geophysical data. The pre-Quaternary surface of the valley generally was similar to the present land surface but had considerably more relief. A map showing contours of the base of the Quaternary deposits can be used as a general guide for water-well drilling and for preliminary determination of the depth to firmest foundation materials. (Knapp-USGS)
W71-04970

A METHOD FOR RELATING INFILTRATION RATES TO STREAMFLOW RATES IN PERCHED STREAMS,
Geological Survey, Tucson, Ariz.
D. E. Burkham.
For sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D266-D271, 1970. 6 p, 3 fig, 6 ref.

Descriptors: *Surface-groundwater relationships, *Alluvial channels, *Infiltration, *Recharge, *Permeability, Water levels, Stage-discharge relations, Discharge (Water), Streamflow, Water levels, Unsteady flow, Duration curves, Hydrograph analysis, Conjunctive use.
Identifiers: Perched water.

A method was developed for relating infiltration rates to streamflow rates for streams that are perched above the water table. The equations derived are based on relations of streamflow rates to width, depth, and velocity and on the assumed relations between infiltration velocity and these parameters. The equations were compared to measured streamflow data for a reach of an ephemeral stream entrenched in alluvium. The bed of the stream normally is coated with fine-grained material deposited during periods of low flow. An equation based on the assumption that infiltration velocity is proportional to stream depth seems to correlate closely with infiltration rates during typical short-duration flows. The layer of fine-grained material on the streambed probably is the main control on the infiltration velocity during these flows. (Knapp-USGS)
W71-04971

THE EFFECT OF STREAM DISCHARGE ON STREAMBED LEAKAGE TO A GLACIAL OUTWASH AQUIFER,
Geological Survey, Columbus, Ohio.
Stanley E. Norris.
For sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D262-D265, 1970. 4 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Surface-groundwater relationships, *Induced infiltration, *Alluvial channels, *Ohio, Water level fluctuations, Withdrawal, Transmissivity, Glacial drift, Recharge, Discharge (Water), Water yield, Streamflow, Water levels.
Identifiers: *Aquifer testing, *Pumping tests.

Five controlled pumping tests of a glacial outwash aquifer, made in a comparatively small area in the Scioto River valley near Piketon, Ohio, showed ranges in aquifer transmissivity from 165,000 to 300,000 gallons per day per foot and in the rate of streambed leakage from 0.21 to 1.15 million gallons per day per acre for each foot of head difference between the stream and the underlying aquifer. The rate of streambed leakage varies with stream discharge and velocity, suggesting that higher flows progressively clean the streambed and increase its permeability. The relation of discharge to streambed leakage is important not only in the design of local groundwater supply facilities, but also because it may be applicable to a large part of the watercourse aquifer system in the lower Scioto River valley. (Knapp-USGS)
W71-04973

VERTICAL MOLECULAR DIFFUSION OF XENON-133 GAS AFTER INJECTION UNDERGROUND,
Geological Survey, Idaho Falls, Idaho.
For primary bibliographic entry see Field 05B.
W71-04977

WATER RESOURCES OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE AND NORTH CAROLINA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W71-04979

HYDROLOGY AND GEOLOGY OF THE HONOLULU AQUIFER,
California Univ., Berkeley. Dept. of Civil Engineering; and General Electric Co., Santa Barbara, Calif. TEMPO.
David K. Todd, and Charles F. Meyer.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 97, No HY2, Paper 7910, p 233-256, February 1971. 24 p, 13 fig, 6 tab, 28 ref, append. OWRR Project B-041-CAL (3).

Descriptors: *Saline water intrusion, *Hawaii, *Aquifers, *Water resources development, *Saline water-freshwater interfaces, Groundwater movement, Drawdown, Water levels, Basalts, Steady flow, Unsteady flow, Pumping, Water table, Stratified flow, Water management (Applied), Saline water systems.
Identifiers: Honolulu aquifer (Hawaii).

In one sub-basin of the highly permeable basalt forming the Honolulu aquifer, the freshwater that floats upon and mixes with underlying sea water has been withdrawn at rates exceeding the sustainable yield, causing shallow drawdown cones with severe upconing of brackish water. Recharge into the area is estimated by three different methods and found to be about 5.3 mgd. By the Theis non-equilibrium method permeability of the basalt is estimated to be 13,700 gpd per sq ft. Relatively impermeable caprock deposits appear to limit leakage of freshwater to the ocean or to adjacent aquifer areas to negligible amounts, since withdrawal at approximately the estimated recharge rate causes no increase in salinity. This study is part of a project to develop a mathematical model and to simulate by use of a digital computer the dynamic behavior of isochlors when freshwater floats on salt water. (Knapp-USGS)
W71-05043

STEADY STATE FLOW AROUND A WELL IN A TWO-LAYERED AQUIFER,
Iowa State Univ., Ames. Dept. of Agronomy.
Muhammad Yunus Khan, Don Kirkham, and Sadik Toksoz.
Water Resources Research, Vol 7, No 1, p 155-165, February 1971. 11 p, 7 fig, 2 tab, 13 ref. OWRR Project B-013-IA (4).

Descriptors: *Groundwater movement, *Aquifers, *Withdrawal, *Hydrogeology, *Drainage wells, Equations, Mathematical studies, Permeability, Isotropy, Drawdown, Recharge, Drainage systems, Pumping, Subsurface drainage, Water table, Saturated flow, Computer programs, Steady flow, Uniform flow, Hydraulic conductivity.

Identifiers: Groundwater-soil water relationships.

Theoretical expressions for the hydraulic head and the stream function are derived for three-dimensional, axisymmetric steady flow around a well in a two-layered aquifer. The aquifer receives a steady vertical recharge, and the well is pumped at a constant rate; the hydraulic head at the outer cylindrical boundary is kept constant. Two sets of flow nets and a table of values are presented to show the effect of hydraulic conductivities of the two layers on flow lines, equipotentials, and the height of the water table. Graphs show the effect of the problem variables on the height of the water table. (Knapp-USGS)
W71-05044

SPACING OF DRAINAGE WELLS IN A LAYERED AQUIFER,
Iowa State Univ., Ames. Dept. of Agronomy.
Muhammed Yunus Khan, and Don Kirkham.
Water Resources Research, Vol 7, No 1, p 166-183, February 1971. 18 p, 5 fig, 2 tab, 10 ref, 2 append. OWRR Project B-013-IA (5).

Descriptors: *Groundwater movement, *Aquifers, *Withdrawal, *Hydrogeology, *Drainage wells, Equations, Mathematical studies, Permeability, Isotopy, Drawdown, Recharge, Drainage systems, Pumping Subsurface drainage, Water table, Saturated flow, Computer programs, Steady flow, Uniform flow.
Identifiers: Groundwater-soil water relationships.

A theory is presented to determine spacing of identical drainage wells that, by discharging groundwater simultaneously from a layered aquifer, will lower a water table to a preassigned level and maintain it. The theory has been developed by solving a mathematical boundary value problem. The wells are located on a certain regular grid, and the aquifer receives a uniform vertical recharge from rainfall or excess irrigation. The theory shows that the spacing depends on the thickness and hydraulic conductivity of each permeable layer tapped by the wells, the maximum allowable drawdown, the uniform vertical recharge, the radius of the wells, and the well grid geometry. A table of values of a function, useful for determining spacing of wells to be tapped in an aquifer that may consist of any number of permeable layers, is given. (Knapp-USGS)
W71-05045

OBJECTIVES OF A CURRENT STUDY OF SALINE GROUNDWATER IN THE TULAROSA BASIN, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 04B.
W71-05067

RECORDS OF WATER-LEVEL MEASUREMENTS IN WELLS IN GALVESTON COUNTY, TEXAS, 1894-1969.
Geological Survey, Houston, Tex.
For primary bibliographic entry see Field 07C.
W71-05069

RECORDS OF WATER-LEVEL MEASUREMENTS IN WELLS IN HARRIS COUNTY, TEXAS, 1966-1969.
Geological Survey, Houston, Tex.
For primary bibliographic entry see Field 07C.
W71-05070

GEOLOGY AND HYDROLOGY OF SELECTED PLAYAS IN WESTERN UNITED STATES.
Massachusetts Univ., Amherst. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W71-05073

GEOLOGY AND HYDROLOGY OF ROGERS PLAYA AND ROSAMOND PLAYA, CALIFORNIA,
Massachusetts Univ., Amherst. Dept. of Geology; and Mobil Oil Corp., Shreveport, La.
For primary bibliographic entry see Field 02J.
W71-05074

GEOLOGY AND HYDROLOGY OF COYOTE PLAYA,
Massachusetts Univ., Amherst. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W71-05075

RESULTS OF TEST-DRILLING AND WINTER MAPPING PROGRAMS ON COYOTE PLAYA, CALIFORNIA,
Massachusetts Univ., Amherst. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W71-05076

RECONNAISSANCE GEOLOGY OF BIG SMOKY PLAYA, NEVADA,
Chevron Oil Co., Jackson, Miss.
For primary bibliographic entry see Field 02J.
W71-05077

GEOLOGY AND HYDROLOGY OF TROY PLAYA, SAN BERNARDINO COUNTY, CALIFORNIA,
Texas Univ., Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 02J.
W71-05078

RECONNAISSANCE GEOLOGY OF CLAYTON PLAYA, NEVADA,
Shell Oil Co., Midland, Tex.
For primary bibliographic entry see Field 02J.
W71-05079

SOME HYDROLOGIC AND GEOLOGIC PROCESSES INFLUENCING PLAYA DEVELOPMENT IN THE WESTERN PART OF THE BASIN AND RANGE PROVINCE, UNITED STATES,
Massachusetts Univ., Amherst. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W71-05080

GROUNDWATER RESOURCES OF THE CLATSOP PLAINS SAND-DUNE AREA, CLATSOP COUNTY, OREGON,
Geological Survey, Washington, D.C.
F. J. Frank.
For sale by the Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $1.00. Geological Survey Water-Supply Paper 1899-A, 1970. 41 p, 8 fig, 1 plate, 8 tab, 15 ref.

Descriptors: *Water resources, *Groundwater, *Oregon, Hydrogeology, Hydrologic data, Data collections, Geology, Water wells, Aquifers, Aquifer characteristics, Water table, Water yield, Water quality, Chemical analysis, Water pollution sources, Saline water intrusion, Drawdown, Surface-groundwater relationships, Water resources development, Hydrographs.
Identifiers: *Clatsop county (Oregon), Clatsop Plains.

Although the average annual precipitation of the Clatsop Plains is 78.5 inches, the area has some water supply problems. The area is underlain by Tertiary bedrock of low permeability that stores and yields small quantities of groundwater, which may be of poor chemical quality. This Tertiary bedrock furnishes only minor groundwater discharge to maintain the base flow of streams. The lowlands are overlain by extensive deposits of dune and beach sand that can absorb and store a large percentage of the annual precipitation. In the central part of the dune area, the saturated thickness of the sand ranges from 95 to more than 150 feet. Much of the water now being discharged to the ocean could be recovered by pumping. Three test wells drilled are capable of yielding 100 gallons per minute. It is estimated that 2,500 acre-feet of groundwater per year per square mile of area may be available for withdrawal in the 10-square mile area that is most favorable for development. The water from the dune sand is soft to moderately hard, has a low chloride concentration, and is of generally good chemical quality. Groundwater from shallow depths beneath a few swampy areas is brown and contains excessive concentrations of iron. (Woodard-USGS)
W71-05088

ELECTRICAL-ANALOG-MODEL STUDY OF WATER RESOURCES OF THE COLUMBUS AREA, BARTHOLOMEW COUNTY, INDIANA,
Geological Survey, Washington, D.C.
F. A. Watkins, Jr., and J. E. Heisel.
For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $1.25. Geological Survey Water-Supply Paper 1981, 1970. 22 p, 4 fig, 3 plate, 11 tab, 14 ref.

Descriptors: *Groundwater, *Water resources development, *Analog models, *Indiana, Aquifers, Glacial drift, Aquifer characteristics, Water yield, Specific capacity, Withdrawal, Hydrogeology, Hydrologic data, Water wells, Water levels, Water supply, Forecasting, Water resources.
Identifiers: *Columbus Area (Ind), *Bartholomew County (Ind).

The study area is in part of a glacial outwash sand and gravel aquifer that was deposited in a preglacial bedrock valley. The area extends from the north line of Bartholomew County, Indiana, to the south county line and includes a small part of Jackson County south of Sand Creek and east of the East Fork White River. This report area includes about 100 square miles of the aquifer. Groundwater in the outwash aquifer is unconfined. Results of pumping tests and estimates derived from specific-capacity data indicate that the average horizontal permeability for this aquifer is about 3,500 gallons per day per square foot. An average coefficient of storage of about 0.2 was determined from pumping tests. Transmissibilities range from near zero to about 500,000 gallons per day per foot in the thicker parts of the aquifer. About 800,000 acre-feet of water is in storage in the aquifer. This storage is equivalent to an average yield of 34 million gallons per day for about 21 years without recharge. An electrical-analog model indicates that there is more than enough water to meet the estimated needs of the city of Columbus without seriously depleting the aquifer. The decline in water levels in the Columbus area as predicted by the model for the period 1970-2015 ranged from about 20 feet in the center of the areas of pumping to 3 feet or less in the areas upstream and downstream from these areas of pumping. (Woodard-USGS)
W71-05092

WATER RESOURCES AND GEOLOGY OF GLOUCESTER COUNTY, NEW JERSEY,
Geological Survey, Trenton, N.J.
William F. Hardt, and George S. Hilton.
New Jersey Division Water Policy and Supply Special Report 30, 1969. 130 p, 17 fig, 9 tab, 6 ref.

Descriptors: *Water resources, *Groundwater, *Geology, *New Jersey, Hydrologic data, Water wells, Aquifers, Water yield, Water quality, Data collections, Water levels, Hydrology, Pumping, Water utilization, Water users, Consumptive use, Hydrographs, Aquifer characteristics, Surface waters, Streamflow, Drainage, Low flow, Water table, Precipitation (Atmospheric), Surface-groundwater relationships.
Identifiers: *Gloucester County (N.J.).

Gloucester County, in the southwestern part of New Jersey adjacent to Philadelphia, Pa., Camden, N. J., and Wilmington, Del. in the lower Delaware River valley, has an area of 339 square miles. It is in the Coastal Plain physiographic province and is underlain by unconsolidated sand and clay of Quaternary, Tertiary, and Cretaceous age. These sediments overlie bedrock which consists of metamorphic and igneous rocks of upper Precambrian age. The most important and productive aquifer is the undifferentiated Raritan and Magothy Formations of Late Cretaceous age. The aquifer yields about 75 percent of the groundwater used in the county. Wells tapping this aquifer yield up to 1,400 gpm (gallons per minute). Total groundwater pumpage in the county (1966) was estimated at about 40 mgd which consisted of 15.5 mgd for industrial use; 11 mgd for public supplies; 10 mgd for irrigation; and 3.5 mgd for rural domestic supplies. The chemical quality of groundwater is generally acceptable for most uses, although in some areas objectionable amounts of iron, nitrate, and fluoride are found. Near the Delaware River and in the southeastern part of the county, chloride in the water from the Raritan and Magothy Formations may be a future problem. (Woodard-USGS)
W71-05110

APPROXIMATE SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR FLOW THROUGH A RECTANGULARLY PACKED BED OF SPHERES,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
William McKinley Carson.
PhD Thesis, Idaho University, August 1970. 180 p, 26 fig, 3 tab, 58 ref, 3 append. OWRR Project A-025-IDA (1).

Descriptors: *Groundwater movement, *Numerical analysis, *Computer programs, Equations, Flow, Porous media, Reynolds number, Velocity, Viscosity, Mathematical studies, Percolation, Approximation method.
Identifiers: *Navier-Stokes equations.

Approximate solutions for the Navier-Stokes equations describing fluid flow through a rectangular packing of spheres were obtained for Reynolds numbers of 0.1, 1, 7 and 35. The solutions are based on an Oseen linearization of the full Navier-Stokes equations. The solutions were approximated by triple trigonometric series and the unknown coefficients evaluated using the Galerkin method for error distribution. Friction factors for the packed bed and superficial velocity were evaluated from the velocity functions and are shown to agree with the experimental observations of previous investigators. Based on friction factor and superficial velocity, the Oseen linearization is shown to be valid for packed flow at Reynolds number of 35. (Knapp-USGS)
W71-05111

2G. Water in Soils

SOIL MOISTURE DETECTION WITH IMAGING RADARS,
Kansas Univ., Lawrence. Remote Sensing Lab.
For primary bibliographic entry see Field 07B.
W71-04857

HYSTERESIS DURING INFILTRATION AND REDISTRIBUTION IN A SOIL COLUMN AT DIFFERENT INITIAL WATER CONTENTS,
Grenoble Univ. (France). Dept. of Hydrology.
Georges Vachaud, and Jean-Louis Thony.
Grant 69-01-666 from General Delegation of Scientific and Technical Research, Paris. Water Resources Research, Vol 7, No 1, p 111-127, February 1971. 17 p, 15 fig, 34 ref.

Descriptors: *Hysteresis, *Infiltration, *Evaporation, *Percolation, *Soil water movement, Unsaturated flow, Hydraulic conductivity, Soil physical properties, Saturated flow, Permeameters, Recharge, Soil moisture meters, Nuclear moisture meters, Tensiometers, Gamma rays, Moisture content.
Identifiers: Soil water redistribution.

Experimental results dealing with flow processes involving hysteresis effects in the suction-water content relationship were obtained on a vertical column of soil submitted to the following successive controlled flow conditions: (1) redistribution of water following a constant head infiltration in an initially air-dried column, (2) constant head infiltration followed by redistribution, and (3) constant flux infiltration followed by controlled evaporation and redistribution. Water contents were measured by using gamma ray attenuation, and water suctions were obtained simultaneously from 10 pressure transducers distributed along the soil column, each one being connected to a tensiometer. All the data were punched on tape and treated with a computer. Examination of the changes of water content and water suction at a given depth yielded precise information on hysteretic behavior. The scanning curves for a single reversal can be defined uniquely with reference to the transition water content, the independent domain theory appears to be inadequate for describing soil water hysteresis completely, and hydraulic conductivity can be considered practically unique. (Knapp-USGS)
W71-04858

FLOW THROUGH A TAILINGS POND EMBANKMENT,
Bureau of Mines, Spokane, Wash., and Idaho Univ., Moscow.
For primary bibliographic entry see Field 08D.
W71-04862

FLOW CELL SYSTEM FOR MISCIBLE DISPLACEMENT EXPERIMENTS,
Iowa State Univ., Ames.
Sun-HO Yoo, and Don Kirkham.
Water Resources Research, Vol 7, No 1, p 211-213, February 1971. 3 p, 2 fig, 3 ref. USAEC Contract AT-(11-1)-1269, Report C00-1269-23.

Descriptors: *Soil water movement, *Permeameters, *Tracers, *Tracking techniques, Nuclear meters, Gamma rays, Dispersion, Diffusion, Mixing, Porous media, Steady flow, Laboratory tests, Data collections, Data processing.
Identifiers: Miscible displacement.

Use of a scintillation counting system gives a continuous graphical recording of effluent concentration, as measured by scintillation counts of radioactivity per minute, of a tracer labeling a chemical component of a solution that miscibly displaces another solution in a column of porous medium. The continuous graphical recording, when the horizontal and vertical axes are assigned proper units, gives a breakthrough curve for the miscible displacement process. The equipment obviates the use of fraction collectors. (Knapp-USGS)
W71-04868

CLAY MINERALS IN CALICHE DEPOSITS OF EASTERN NEW MEXICO,
Harvard Univ., Cambridge, Mass. Dept. of Geological Sciences.
L. F. Aristarain.
Journal of Geology, Vol 79, No 1, p 75-90, January 1971. 16 p, 9 fig, 2 tab, 57 ref.

Descriptors: *Caliche, *New Mexico, *Clay minerals, Soil formation, Mineralogy, Illite, Montmorillonite, Kaolinite, Alluvium, Weathering, Diagenesis, Leaching, Calcareous soils, Soil chemistry, Calcium carbonate, Hardpan, Soil types.
Identifiers: Calichification, High Plains (New Mexico).

Relative quantitative estimations were made of clay minerals in samples from twelve profiles of caliche deposits of eastern New Mexico. These profiles represent: High Plains (6), Sacramento Plain (1), Mescalero Plain (1), and Orchard Park (2) and Blackdom (2) Terraces of the Pecos River. The typical clay mineral association is illite, montmorillonite, kaolinite, and chlorite. Randomly mixed layers of illite and montmorillonite; illite and chlorite; and illite, montmorillonite, and chlorite are present in small amounts. Illite is the most abundant clay mineral and markedly increases toward the top of the profiles. Illite content varies inversely with both kaolinite and montmorillonite. The variations of kaolinite and montmorillonite are approximately parallel. In half of the samples, kaolinite is slightly more abundant than montmorillonite, and the contrary occurs in the other half. In profiles of deposits with a low degree of calichification, illite is the most abundant clay mineral, but the other relationships do not apply. By comparing the clay minerals present in caliche profiles with published results for various soil types, analogies with chernozem and desert soil are noted. (Knapp-USGS)
W71-04871

A NEW METHOD OF DETECTING LEAKS IN RESERVOIRS OR CANALS USING LABELLED BITUMEN EMULSIONS (FRENCH),
CEA, Center of Nuclear Study of Grenoble, and Societe routiere Colas, Paris, France.
For primary bibliographic entry see Field 04A.
W71-04879

BIOGEOCHEMICAL INVESTIGATIONS IN THE RUDNYY ALTAY,
Akademiya Nauk SSSR, Moscow. Institut Geokhimii i Analiticheskoi Khimii.
For primary bibliographic entry see Field 02K.
W71-04895

REMOTE SENSING OF HYDROLOGIC RESOURCES IN THE GREAT PLAINS, REPORT 1,
South Dakota State Univ., Brookings. Remote Sensing Inst.
For primary bibliographic entry see Field 07B.
W71-05091

SOME RECENT RESEARCH ON LAND DRAINAGE,
Iowa State Univ., Ames. Water Resources Research Inst., and Alexandria Univ. (Egypt). Dept. of Soil Sciences.
For primary bibliographic entry see Field 04A.
W71-05102

MINERALOGY OF A PLAYA SOIL AND UNDERLYING SEDIMENTS FROM THE HIGH PLAINS MEDIUM-TEXTURED SOIL ZONE,
Texas Tech. Univ., Lubbock. Dept. of Soil Science.
For primary bibliographic entry see Field 02J.
W71-05112

STABILITY OF CLOSED HORIZONTAL DRAINAGE IN THE GOLODNAYA STEPPE,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 08D.
W71-05254

TRANSPORT ANALYSIS-BASIC PREDICTIVE APPROACH OF THE MOVEMENT OF POLLUTANTS THROUGH SOIL,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05B.
W71-05264

PERCOLATION OF CITRUS WASTES THROUGH THE SOIL,
Engineering--Science Inc., Arcadia, Calif.

For primary bibliographic entry see Field 05D.
W71-05275

2H. Lakes

SOME OBSERVATIONS ON THE EFFECT OF WIND INDUCED THERMAL MIXING,
Saskatchewan Research Council, Saskatoon.
For primary bibliographic entry see Field 02D.
W71-04864

WATER QUALITY CHARACTERISTICS OF THE NEW HOPE AND LOWER HAW RIVERS JULY 1966 - FEB. 1970 WITH ESTIMATES OF THE PROBABLE QUALITY OF NEW HOPE LAKE,
North Carolina Water Resources Research Inst., Raleigh; and North Carolina Univ., Chapel Hill. Dept. of Environmental Biology.
For primary bibliographic entry see Field 05B.
W71-04932

A PROGRAM OF RESEARCH FOR THE CATFISH FARMING INDUSTRY.
Bureau of Commercial Fisheries, Ann Arbor, Mich.

Available from NTIS as COM-71-00049, $3.00 in paper copy, $0.95 in microfiche. Economic Development Administration Report, EDACOMM-70-015, Sept 1970. 233 p.
Identifiers: *Fisheries, Economic development, *Catfishes, *Aquaculture, Surveys, Methodology, Feeding stuffs, Harvesting, Processing, Marketing, Food services, Ponds, Lakes, Equipment, Statistical data, Profits, *Fish farms.

The history and current state of the industry, improvement of harvesting methods and equipment, and present and future markets including pay-lakes and restaurants are reported. Research results are reported as regards catfish processing and feedstuffs and diets for catfish. A survey of fish farming in 12 states revealed that adult catfish were being reared on 30,330 acres, minnows on 26,866 acres, and fingerling catfish on 6,782 acres. The states of Mississippi and Arkansas account for 75 percent of the adult catfish, 74 percent of the fingerling catfish, and 83 percent of the minnow acreages. There were 804 fish farmers cultivating adult catfish, 429 raising fingerling catfish, and 292 rearing minnows. The weighed mean stocking rate was 1,763 fish per acre while the module stocking rate was 1,500 fish per acre. Only 23 fish farmers gave data on stocking rates for fingerling catfish and the weighed mean stocking rate reported by them was 27,468 fish per acre.
W71-04953

THE PRESENCE OF TRUE HALOPHILIC BACTERIA IN WATERS OF SPRINGS AND LAKE CHAMBON, (IN FRENCH),
Centre Hospitalier et Universitaire de Vienne (France).
Jean Brisou, and Richard Moreau.
Comptes Rendus Academie des Sciences, Paris, Vol 268, No 20, p 2525-2526, 1969. 4 ref.

Descriptors: *Halophytes, *Freshwater, Rivers, Lakes, Springs, Bacteria, Geologic time, Aquatic bacteria.
Identifiers: *Lake Chambon (France), Empedobacter halmephilium, Sarcina litoralis.

Contrary to general beliefs, the distribution of halophilic bacteria is not confined to seas and saline lakes and marshes. Investigations disclosed a great number of facultative and strictly halophilic bacteria in fresh water of rivers. In particular this is true of spring waters of the central uplands of France and Lake Chambon. This study identified two strains of Empedobacter halmephilium and one strain of Sarcina litoralis. The presence of these bacteria outside of saline waters may provide some information on the geological history of the land. (Wilde-Wisconsin)
W71-04960

DEVELOPMENTAL HISTORY OF SCHOHSEE SHOWN BY MICROSCOPICAL AND CHEMICAL INVESTIGATIONS, (IN GERMAN),
Max-Planck-Institut fuer Limnologie zu Ploen (West Germany).
Massoud A. H. Saad.
English summary. Archiv fur Hydrobiologie, Vol 67, No 1, p 32-77, 1970. 23 fig, 1 tab, 75 ref.

Descriptors: *Productivity, *Lakes, Allogenic succession, Geologic time, History, Dating, Analysis.
Identifiers: *Schohsee (Germany).

Long core samples were collected from the bottom of the Schohsee with a modified Livingstone corer. The results of pollen and chemical analyses indicated that since its origin in the late glacial time up to the Boreal period the lake had a relatively low productivity. The biogenci production increased considerably in the Atlanticum. The limnological quality of the lake persisted for about 5000 years, but in the Subatlanticum had undergone a gradual decline. In the beginning of this century, the autochthonous production was augmented by eutrophication caused by human activity. (Wilde-Wisconsin)
W71-04963

A PALEOHYDROLOGIC MODEL FOR MINERALIZATION OF THE WHITE PINE COPPER DEPOSIT, NORTHERN MICHIGAN,
Geological Survey, Beltsville, Md.
Walter S. White.
Economic Geology, Vol 66, No 1, p 1-13, January-February 1971. 13 p, 3 fig, 4 tab, 18 ref.

Descriptors: *Paleohydrology, *Mathematical models, *Groundwater movement, *Ion transport, *Water chemistry, Aqueous solutions, Geology, Copper, Geochemistry, Mineralogy, Michigan, Leaching, Water circulation.
Identifiers: *Copper ores, Keweenawan rocks.

Physical properties of the upper Keweenawas rocks can be measured or inferred within a sufficiently narrow range for quantitative evaluation of various paleohydrologic models for the origin of the White Pine copper deposit. The models involve lateral migration of fluids through the subjacent Copper Harbor Conglomerate to the site of the deposit, and stripping of copper from these solutions in the Nonesuch Shale. The calculations reveal limitations to theories of origin that would not be evident from purely qualitative consideration; some of these limitations could be useful to exploration. For example, if the water was yielded by compaction of the Copper Harbor Conglomerate and contained 50 ppm Cu, there must have been significant convergence of solution paths toward White Pine. Surface water entering the Copper Harbor Conglomerate on the north limb of the Lake Superior syncline is an adequate source if the point of entry was once significantly higher than the water table at White Pine; this model implies a major copper deposit at great depth north of the axis of the syncline. Groundwater entering the Nonesuch Shale up dip from White Pine is not a possible source of mineralizing solutions. (Knapp-USGS)
W71-05058

LAKES--RESTORATION AND PRESERVATION,
Federal Water Quality Administration, Cincinnati, Ohio. Field Investigations Branch.
For primary bibliographic entry see Field 05C.
W71-05082

SUBMERSIBLE RECORDING CURRENT AND WATER QUALITY METERS,
Ontario Water Resources Commission, Toronto.
For primary bibliographic entry see Field 05A.
W71-05084

HYDROLOGIC REGIMEN OF WALKER LAKE, MINERAL COUNTY, NEVADA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W71-05095

EFFECTS OF THERMAL DISCHARGES ON THE MASS ENERGY BALANCE OF LAKE MICHIGAN,
Argonne National Lab., Ill.
For primary bibliographic entry see Field 05C.
W71-05119

AIRBORNE TEMPERATURE SURVEYS OF LAKE MICHIGAN, OCTOBER, 1966 AND 1967,
Michigan Univ., Ann Arbor. Great Lakes Research Div; and Naval Oceanographic Office, Washington, D.C.
For primary bibliographic entry see Field 07B.
W71-05120

GREAT LAKES THERMAL STUDIES USING INFRARED IMAGERY,
Department of Energy, Mines and Resources, Burlington (Ontario). Canada Center for Inland Waters.
For primary bibliographic entry see Field 07B.
W71-05123

GREAT LAKES SNOWSTORMS. PART 1. CLOUD PHYSICS ASPECTS,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
For primary bibliographic entry see Field 02C.
W71-05153

GREAT LAKES SNOWSTORMS, PART 2. SYNOPTIC AND CLIMATOLOGICAL ASPECTS,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
James E. Jiusto, Douglas A. Paine, and Michael L. Kaplan.
Available from NTIS as COM-71-00011, $3.00 in paper copy, $0.95 in microfiche. May 1970. 58 p, 24 fig, 7 tab, 16 ref. ESS Grant E22-13-69 (G).
Identifiers: *Snowstorms, *Great Lakes, *Climatology, Analysis, Air water interactions, Cloud physics, Vortices, Convention, Atmospheric motion, Snow fall, Reduction, Crystals, Supercooling, Meteorological radar, Statistical analysis, Precipitation, Meteorology, Lake Erie, Lake Ontario, Lake effect snowstorms.

A secondary perturbation of trough has been found in some deep cyclonic systems which appears to play an important role in mesoscale lake effect storms. In two cases such a trough's associated positive vorticity field provided organized ascent in the region between 850 mb and 600 mb. In the November 1967 storm, air parcels traveling between the 850 mb and 700 mb levels underwent one to six thousand foot ascents. This ascent, in turn, provided a moist environment which enhanced cloud growth, nearly doubling cloud depths in the 1968 case. While examining synoptic-mesoscale interactions, it is equally important to recognize the role played by organized descent over a particular lake. Subsidence commonly occurs in the negative vorticity area located ahead of the secondary trough and behind the cold front. This descent is envisioned as effectively capping convective motions at the resulting inversion while drying out the environment beneath the stable layer. A numerical model now being developed will provide an important input of initial and changing boundary conditions for complementing meso- and microscale studies. The model's predicted vorticity field at three hour intervals will yield a measure of the changing values of a synoptically imposed vertical motion pattern, plus its subsequently created moisture environment.
W71-05154

FISH AND CRAYFISH MORTALITIES DUE TO AN INTERNAL SEICHE IN GEORGIAN BAY, LAKE HURON,
Department of Lands and Forests, Maple (Ontario). Research Branch.
For primary bibliographic entry see Field 05C.
W71-05208

FISHERY IMPLICATIONS ASSOCIATED WITH PROLONGED TEMPERATURE AND OXYGEN STRATIFICATIONS,
Arizona Cooperative Fishery Unit, Tucson.
For primary bibliographic entry see Field 05C.
W71-05209

THE TEMPERATURE STRUCTURE OF A MID-LATITUDE, DIMICTIC LAKE DURING FREEZING, ICE COVER, AND THAWING,
Cold Regions Research and Engineering Lab., Hanover, N.H.
W. H. Parrott, and W. M. Fleming.
Available from NTIS as AD-715 716, $3.00 in paper copy, $0.95 in microfiche. Research Report 291, Nov 1970. 21 p, 17 fig, 1 tab, 32 ref.
Identifiers: *Lakes, Temperature, *Ice, Lakes, Freezing, Melting, Thermocouples, Cooling, Thermal properties, Ice formation, Ice breakup, Limnology.

The temperature structure of Post Pond, a small (46.6 hectares), mid-latitude, dimictic lake in west-central New Hampshire, was studied during autumn, winter and spring of 1968-1969. The lake was instrumented over its maximum depth (11.7 m) with a string of 24 thermocouples which recorded hourly temperatures. Temperatures in 9 m of sediments underlying the lake were measured with a thermistor probe. Secondary and tertiary thermocline development in the epilimnion occurred during short warming periods in the early autumn. The autumn overturn lasted 25 days, whereas the spring overturn lasted only 4 days. The entire lake mixed isothermally in the autumn to 3.2 C. During the period of ice cover, the lower 5 m of water gained approximately 51.5 cal/cm sq, which was supplied by stored heat in the bottom sediments. A steady-state thermal gradient of 0.07 deg C/m was found for the deeper sediments underlying the lake during ice cover. Late winter cooling of bottom water under the ice cover may be the result of snowmelt in areas adjacent to the lake causing activation of groundwater influx. Melting of the clear ice portion of the ice cover was primarily the result of heat supplied to the lake from snowmelt water, and occurred on the underside of the ice sheet. Thermal instability of the water mass persisted for 9 days during peak snowmelt runoff; this can be partially explained by an increase in dissolved solids with depth.
W71-05259

2I. Water in Plants

ON THE NUTRITION AND METABOLISM OF ZOOPLANKTON. VII. SEASONAL SURVEY OF NITROGEN AND PHOSPHORUS EXCRETION BY CALANUS IN THE CLYDE SEA-AREA,
Marine Biological Association of the United Kingdom, Plymouth (England). Lab.; and Marine Biological Station, Millport (Scotland).
E. I. Butler, E. D. S. Corner, and S. M. Marshall.
Journal of the Marine Biological Association of the United Kingdom, Vol 50, No 2, p 525-560, 1970. 5 fig, 9 tab, 43 ref.

Descriptors: *Zooplankton, *Metabolism, *Absorption, Exudation, Nitrogen, Phosphorus, Consumptive use.
Identifiers: *Winter feeding, Calanus finmarchicus, Calanus helgolandicus.

Body weight, nitrogen, phosphorus, and levels of nitrogen and phosphorus excretion were determined in females, males and stage V of Calanus finmarchicus and C helgolandicus. Maximum of plant food in terms of chlorophyll a was observed in early April, mid-May, and early September. Excretion of nitrogen and phosphorus was at its peak in April. The rate of excretion was correlated with the level of nutrients. The sex and age of animals did not influence significantly the nitrogen: phosphorus ration. In late April, 26.8% of the captured nitrogen and 17.2% of phosphorus were invested in growth. The findings suggest that the concept of superfluous feeding is not applicable to Calanus during the spring period. (Wilde-Wisconsin)
W71-04965

SEASONAL CHANGES OF CALORIC VALUES OF LAKE PLANKTON, (IN RUSSIAN),
Minsk Univ. (USSR).
A. P. Ostapenya, and Yu G. Giginyak.
Doklady Akademii nauk BSSR, Vol 14, No 1, p 77-79, 1970. 1 fig, 1 tab, 6 ref.

Descriptors: *Plankton, *Energy, *Lipids, Ecosystems, Copepods, Organic matter, Daphnia.
Identifiers: *Caloric values, Belorussian lakes, Cladocerans, Diaptomus graciloides, Daphnia cucullata, Daphnia hyalina, Oscillatoria rubescens, Subglacial flowering, Winter maxima.

The caloric values of organisms serve as important indicators in appraisals of energy relations of planktonic ecosystems. In this study of Belorussian lakes of different trophic levels, the calories of copepods and cladocerans were determined during different periods of the year by a modified method of dichromate oxidation. Regardless of the nature of water, caloric value of organic matter attained its maximum in February. The high caloric values are attributed largely to accumulation of lipids in the bodies of organisms, increasing with lower temperatures from about 10 to 40%. (Wilde-Wisconsin)
W71-04966

PRIMARY PRODUCTION MEASUREMENTS ON A NATURAL PLANKTON BLOOM,
Bedford Inst., Dartmouth (Nova Scotia). Marine Ecology Lab.
Trevor Platt, and D. V. Subba Rao.
Journal Fisheries Research Board of Canada, Vol 27, No 5, p 887-899, 1970. 2 fig, 2 tab, 26 ref.

Descriptors: *Primary productivity, *Phytoplankton, *Measurement, Plankton, Test procedures, Cultures, Laboratory tests.
Identifiers: Phytoplankton blooms, Caloric values, Trichromatic equations.

The samplings were made one mile from the shore of Nova Scotia at six depths from 1 to 40 meters. Analyses included determinations of primary production by the in situ C-14 method, photosynthesis: respiration and chlorophyll c: chlorophyll a ratios, particulate carbon, ash content, phosphorus, silica, nitrates, incident radiation, and transparency. The observations suggested that culture trails provide satisfactory analogues of natural plankton systems under bloom conditions. As inferred from calorific values, phytoplankton in senescent stages of the bloom has no tendency to store fat. No single quantity served as an indicator of the physiological vigor of the plant community. (Wilde-Wisconsin)
W71-04967

THE EFFECT OF SEA WATER ON CARBON DIOXIDE EXCHANGE BY THE HALOPHYTE LIMONIUM CALIFORNICUM (BOISS.) HELLER,
Oxford Univ. (England). School of Botany; and Stanford Univ., Calif. Dept. of Biological Sciences.
S. R. J. Woodell, and H. A. Mooney.
Annals of Botany; Vol 34, No 134, p. 117-121, January 1970. 3 fig, 9 ref.

Descriptors: *Salt marshes, *Photosynthesis, *Halophytes, *Saline water, *Respiration, Carbon dioxide, Laboratory tests, Mode of action, Physiological ecology, Root systems, Environmental effects, Metabolism, Stomata.

Coastal salt marsh plants live in an environment characterized by sudden and extreme changes in salt concentrations. The effects of sudden soil salinity changes on photosynthesis and respiration were compared in a halophytic species and a non-halophytic species. Plants of Limonium californicum (a salt-marsh halophyte) and Phaseolus vulgaris were cultivated under identical conditions and suddenly subjected to sea water around their root systems. Carbon dioxide consumption or production was measured for 20 hrs. in the light and in the dark. Both species showed initial increases in photosynthetic rates immediately after introduction of sea water. In the case of Limonium, photosynthesis was 85% of the initial rate 17 hrs. later, while respiration declined steeply, followed by a strong recovery 4.5 hrs. later. With Phaseolus, photosynthesis declined steeply after the initial increase and this was paralleled by a decline in respiration. It is felt that the initial photosynthesis decrease resulted from temporary stomatal opening due to decreased water uptake in Phaseolus. By contrast, the halophyte was able to maintain relative stability through some unknown mechanism. It does possess salt glands, which may have facilitated adjustment to the new osmotic conditions. (Casey - Arizona)
W71-05196

SELECTION AND MANAGEMENT OF IRRIGATED PASTURE MIXTURES,
Agricultural Research Service, Denver, Colo, and Montana Agricultural Experiment Station, Bozeman. Huntley Branch; and Montana Agricultural Experiment Station, Bozeman. Northwestern Branch.
For primary bibliographic entry see Field 03F.
W71-05198

CONSUMPTIVE IRRIGATION REQUIREMENTS FOR CROPS IN IDAHO,
Idaho Univ., Moscow. Dept. of Agricultural Engineering; and Idaho Water Resource Board.
For primary bibliographic entry see Field 03F.
W71-05201

2J. Erosion and Sedimentation

SPLASH AMOUNTS FROM WATERDROP IMPACT ON A SMOOTH SURFACE,
Agricultural Research Service, Morris, Minn. Soil and Water Conservation Research Div.
Calvin K. Mutchler.
Water Resources Research, Vol 7, No 1, p 195-200, February 1971. 6 p, 3 fig, 3 tab, 5 ref.

Descriptors: *Impact (Rainfall), *Hydraulic models, *Raindrops, Rainfall, Laboratory tests, Velocity, Depth, Ponding, Soil erosion, Simulated rainfall, Rainfall simulators.
Identifiers: *Raindrop impact, *Splash erosion.

The mechanics of raindrop splash erosion of soil were investigated by using waterdrops impacting at terminal velocity onto various depths of water over smooth glass. Splash weight produced by waterdrop impact varied with waterdrop diameter D and surface water depth d. For a smooth hard surface, predicted splash in terms of waterdrop weight was zero at d/D—0 and increased to a maximum at d/D of 0.14 and 0.20 for D—0.559 cm and 0.296 cm, respectively. The influence of greater depth became relatively insignificant at a depth of about three drop diameters. (Knapp-USGS)
W71-04865

ON THE TECTONIC AND MORPHOLOGIC CLASSIFICATION OF COASTS,
Scripps Institution of Oceanography, La Jolla, Calif.
D. C. Inman, and C. E. Nordstrom.
Journal of Geology, Vol 79, No 1, p 1-21, January 1971. 21 p, 5 fig, 8 tab, 37 ref.

Descriptors: *Coasts, *Geomorphology, *Geology, *Classification, Geologic control, Structural geology, Land forming, Marine geology, Topography, Erosion, Sedimentation.
Identifiers: Tectonics.

In terms of the gross first-order effects of plate tectonics, there appear to be three major classes of coasts and several subclasses, depending upon their position relative to the moving plates of the tectosphere: (1) collision coasts, that is, those on the collision edge of continents and island arcs; (2) trailing-edge coasts, that is, those on the trailing edge or noncollision side of a continent; and, (3) marginal sea coasts protected by island arcs. The trailing-edge coasts range in form from the tectonically new coasts facing beginning separation centers to the morphologically active coasts bordering the debris plains formed from the erosion products of the continents. The good coherence between certain morphologic and tectonic features of coasts was used as a guide in formulating a purely morphologic classification with tectonic implications. The morphologic classification is defined simply in terms of the width of the continental shelf and the relief of the adjacent land forms: (1) mountainous coasts; (2) narrow-shelf hilly, and plains coasts; and (3) wide-shelf hilly, and plains coasts. (Knapp-USGS)
W71-04869

A SIMULATION MODEL OF A COMPLEX RECURVED SPIT,
Nottingham Univ. (England). Dept. of Geography.
Cuchlaine A. M. King, and M. F. McCullagh.
Journal of Geology, Vol 79, No 1, p 22-37, January 1971. 6 p, 8 fig, 2 tab, 3 ref.

Descriptors: *Simulation analysis, *Sand spits, *Sand bars, *Mathematical models, Littoral drift, Shoals, Waves (Water), Winds, Currents (Water), Geomorphology, Surf, Shores, Computer programs.
Identifiers: Hurst Castle spit (England).

A simulation model of a coastal spit is presented to illustrate the value of such models in studying the processes that lead to spit formation. Hurst Castle spit in Hampshire, England was chosen for the model because it has a distinctive form due to the operation of several easily identified wave types. The main ridge, which is composed of shingle, is lengthened by westerly waves, while storm waves build it up. The recurves are formed of material drifted round the end of the main ridge by waves from the south. Waves from the northeast, coming down the Solent, build the lateral recurves. These become longer and more numerous toward the distal end of the spit. The computer program simulates the operation of waves from the west, storm waves, southeasterly waves, and waves from the northeast. In addition, a depth factor simulates the increasing depth of water offshore. This accounts for the increase in number of recurves toward the distal end. A refraction factor allows the curvature of the main ridge to be simulated. The proportion of random numbers allocated to these variables can be adjusted in the data input to elucidate the part they play in the formation of the spit. The close fit of the standard spit to the real spit suggests that the controlling variables are being correctly simulated. (Knapp-USGS)
W71-04870

CLAY MINERALS IN CALICHE DEPOSITS OF EASTERN NEW MEXICO,
Harvard Univ., Cambridge, Mass. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02G.
W71-04871

THE MULTIPLE CAUSALITY OF BARRIER ISLANDS,
Western Washington State Coll., Bellingham. Dept. of Geology.
Maurice L. Schwartz.
Journal of Geology, Vol 79, No 1, p 91-94, January 1971. 4 p, 3 fig, 13 ref.

Descriptors: *Sand spits, *Sand bars, *Sedimentation, Sedimentary structures, Coast, Beaches, Deposition (Sediments), Sediment transport, Waves (Water), Geomorphology, Littoral drift, Winds, Currents (Water), Surf, Shores.
Identifiers: Barrier islands.

There is wide disparity in the current literature concerning the origin of barrier islands. The acceptance of multiple causality is advocated here, and a new classification is proposed. Three basically different explanations of the formation of barrier islands are proposed: (1) upbuilding of offshore bars; (2) cutting of inlets through spits; and (3) submergence of ridgelike coastal features. It is feasible that any of these causes, proceeding independently or in concert, can form barrier islands. (Knapp-USGS)
W71-04872

GLASSY OBJECTS IN TERTIARY DEEP-SEA CLAYS CORED BY THE DEEP SEA DRILLING PROJECT,
Scripps Institution of Oceanography, La Jolla, Calif.
C. C. Von Der Borch.
Marine Geology, Vol 10, No 1, p 5-14, January 1971. 10 p, 4 fig, 3 tab, 13 ref.

Descriptors: *Bottom sediments, *Pacific Ocean, *Mineralogy, *Igneous rocks, Clays, Cores, Volcanoes, Petrology, Sedimentation.
Identifiers: *Glass (Volcanic).

Small glassy spheres, ellipsoids, teardrops, cylinders and dumbbells occur in large numbers in Tertiary deep sea clays cored in the northeastern Pacific by the Deep Sea Drilling Project. These objects morphologically resemble microtektites, but have the composition of an oceanic tholeiite. On the basis of their composition and stratigraphic relationship it is considered that they are of volcanic origin and most likely have been formed in deep water by submarine volcanic processes. (Knapp-USGS)
W71-04874

MINERALOGY AND DIAGENESIS OF SOME SOUTH AFRICAN COASTAL AND MARINE CARBONATES,
Cape Town Univ., South Africa. Dept. of Geology.
W. G. Siesser.
Marine Geology, Vol 10, No 1, p 15-38, January 1971. 24 p, 6 fig, 3 tab, 23 ref.

Descriptors: *Beaches, *Bottom sediments, *Calcite, *Diagenesis, Carbonates, Magnesium carbonates, Mineralogy, Ion exchange, Distribution patterns, Dunes, Sands, Geochemistry.
Identifiers: *Aragonite, South Africa.

The dominant carbonate minerals in South African dune, beach, coastal bay, continental shelf, and upper slope environments are aragonite and low-magnesian calcite. In the area studied, there is little difference between the carbonate mineralogy of the beaches and dunes, but the beach-dune environment contains considerably more aragonite and less low-magnesian calcite than the marine environment. Mean high-magnesian calcite values are strikingly uniform for all environments, differing less than 1% between the marine and beach-dune environments. High-magnesian calcite, which is considered the most sensitive mineral to diagenetic changes, shows no mineralogic alteration in the beach-dune environment, but does in sediments presently in the marine environment. Diagenetic alteration of high-magnesian calcite to low-magnesian calcite occurred as a result of prolonged subaerial exposure of the continental shelf during Pleistocene sea-level fluctuations. Recent beach-dune sediments have not been sufficiently isolated from the marine environment to allow alteration of high-magnesian calcite. (Knapp-USGS)
W71-04875

SAND WAVES IN THE SOUTHERN BIGHT OF THE NORTH SEA,
Rijkswaterstaat-Deltadienst, Hague 9netherlands).
J. H. J. Terwindt.
Marine Geology, Vol 10, No 1, p 51-67, January 1971. 17 p, 8 fig, 4 tab, 11 ref.

Descriptors: *Sand waves, *Ripple marks, *Bottom sediments, *Continental shelf, Sedimentary structures, Currents (Water), Waves (Water), Storms, Sands.
Identifiers: *North Sea.

North of the Hinder Banks of the North Sea, sand waves are found, 3-15 m high, with the steep side to the south. Further to the north the steep sides of the sand waves are directed northward. There is no explanation as yet for this phenomenon. In one location it was observed that the height of the sand wave crests is related to the frequency of occurrence of heavy gales and the length of calm weather periods. The maximum observed variation in the height of the sand wave crests was about 2 m. Wandering mega-current ripples (height 0.2-2 m) were observed on the flanks of the sand waves. The crests of these current ripples often make an angle with the sand wave crests. In many locations it was observed that the travelling direction of these ripples (according to their asymmetry) is directed towards the crest of the sand wave from both sides. The grain size differs significantly from one place to another. (Knapp-USGS)
W71-04876

A CLAY MINERAL INVESTIGATION OF SIX CORES FROM THE GULF OF MEXICO,
Research Council of Alberta, Edmonton; and Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
D. W. Scafe, and G. W. Kunze.
Marine Geology, Vol 10, No 1, p 69-85, January 1971. 17 p, 8 fig, 3 tab, 21 ref.

Descriptors: *Bottom sediments, *Gulf of Mexico, *Mineralogy, *Clay minerals, Montmorillonite, Kaolinite, Illite, Sands, Silts, Quartz, Clays, Provenance, Differential thermal analysis, X-ray diffraction, Particle size, Centrifugation.
Identifiers: Chlorite, Feldspars.

Samples were studied from each color change in six gravity cores from nearshore to deep-sea areas in the Gulf of Mexico. Analytical methods and techniques used to characterize the sediments were X-ray diffraction, differential thermal analysis, cation exchange capacity, particle size distribution and fractionation of the clay-size material with the supercentrifuge. The clay minerals and semi-quantitative estimates of their abundance suggest that the sum of source conditions has remained constant during and since Pleistocene time represented by the cores in this study. Montmorillonite and kaolinite are not more abundant in warm water than in cold water sediments and illite and chlorite are not more abundant in cold water than in warm water sediments from the Gulf of Mexico. Silt and clay-size materials are approximately equal except for the cores farthest from the Mississippi Delta where clay-size material dominates. In the clay-size fraction, montmorillonite is generally more abundant than illite, while daolinite comprises less than 20% and chlorite less than 7%. Quartz and feldspar exist only in the 2-0.2 micron portion of the clay-size fraction. (Knapp-USGS)
W71-04877

COBALT AND TANTALUM TRACERS MEASURED BY ACTIVATION ANALYSIS IN SEDIMENT TRANSPORT STUDIES,
Inst. for Soil Fertility, Haren; Delft Hydraulics Lab.; and Reactor Inst., Delft, Netherlands.
For primary bibliographic entry see Field 02L.
W71-04887

GEOCHEMISTRY OF LITHIUM IN THE SEDIMENTARY CYCLE,
Akademiya Nauk SSSR, Moscow. Institut Geokhimii i Analiticheskoi Khimii; and Moscow State Univ. (USSR). Dept. of Geochemistry.
For primary bibliographic entry see Field 02K.
W71-04893

ATLANTIC CONTINENTAL SHELF AND SLOPE OF THE UNITED STATES -- GRAVELS OF THE NORTHEASTERN PART,
Geological Survey, Washington, D.C.
John Schlee, and Richard M. Pratt.
For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402 - Price $2.00. Geological Survey Professional Paper 529-H, 1970. 39 p, 18 fig, 5 plate, 101 ref.

Descriptors: *Sediment transport, *Gravels, *Northeast U. S., *Continental shelf, *New England, Continental slope, Alluvium, Glaciers, Geomorphology, Glacial drift, Sediments, Particle size, Soil types, Rocks, Lithification, Sedimentary rocks, Sedimentology, Petrography.
Identifiers: *Gulf of Maine, Scotian Shelf, Georges Bank.

This report investigates (1) the patterns of gravel dispersal, (2) the processes of gravel deposition, and (3) the bedrock geology of the Gulf of Maine. Gravel has been deposited on the continental margin off New England (1) in the Gulf of Maine-Scotian Shelf-Georges Bank complex and (2) as scattered patches on the continental shelf south of New England and east of New Jersey. The greatest amounts and largest sizes of gravel are in the exit channels (Great South Channel and Northeast Channel) from the Gulf of Maine that flank Georges Bank. The gravel on the Scotian Shelf is intermediate between that of the Gulf of Maine and Georges Bank. Till-like sediment is near better sorted gravelly sand. Pebble roundness is variable. Pebbles are granitic south of Nova Scotia but are mixed with schist and gneiss. Schist and gneiss are more prevalent southwest of Nova Scotia. (Woodward-USGS)
W71-04969

CLAY MOBILITY IN LANDSLIDES, VENTURA, CALIFORNIA,
Columbia Univ., New York. Dept. of Geology; and Getty Oil Co., Ventura, Calif. , Dept. of Engineering.
Paul F. Kerr, Robert A. Stroud, and Isabella M. Drew.
American Association of Petroleum Geologists Bulletin, Vol 55, No 2, p 267-291, February 1971. 25 p, 24 fig, 4 tab, 15 ref.

Descriptors: *Landslides, *Clay, *California, Soils, Mass wasting, Creep, Movement, Mudflows, Soil erosion, Soil conservation, Groundwater movement, Soil mechanics, Drainage programs, Infiltration.
Identifiers: *Ventura oil field (Calif), *Landslide control.

Landslides cover about 345 acres, or 45% of the eastern producing area of the Ventura Avenue oil field, California. By the end of 1969, 61 oil wells were destroyed by landslide activity. A major slide in January 1968 involved more than 1 million cu yd of material and traveled 100 ft within a few minutes. In general, however, slides have been controlled and movement has been slow. The landslides occur mostly in massive granular sandstones of the middle Pico Formation (Pliocene) which are intercalated at irregular intervals with clay-bearing strata. The sandstone is a granular and poorly cemented subangular, porous arkose. Clay strata are ordinarily thin but contain substantial amounts of montmorillonite with some illite and a minor content of kaolinite. The clay-water mixture probably is the most important factor in landslide mobility at Ventura, although slope, structure, and compaction require proper consideration. For the most part, control of moisture has proved to be the most rewarding measure. (Knapp-USGS)
W71-05047

ANALYSIS OF SCALLOP PATTERNS BY SIMULATION UNDER CONTROLLED CONDITIONS,
University of Western Ontario, London. Dept. of Geography, and McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M. F. Goodchild, and D. C. Ford.
Journal of Geology, Vol 79, No 1, p 52-62, January 1971. 11 p, 5 fig, 3 tab, 14 ref.

Descriptors: *Erosion, *Karst, *Limestones, *Caves, Ripple marks, Subsurface drainage, Carbonate rocks, Weathering, Water chemistry.
Identifiers: Erosion (Solution), Scallop patterns (Erosion).

Working with plaster of paris in an experimental flume, the formation of scallop patterns, a feature of eroded limestone, was simulated under controlled conditions of velocity and viscosity. Analysis of the resulting scallop lengths as a frequency distribution shows that some of the statistical parameters are well correlated with the hydrodynamic conditions. Length is inversely related to velocity and directly to viscosity. These results are similar to those found in a theoretical dimensional analysis of the simpler flute problem. Observations in limestone caverns show that these results apply to scallops generated on limestone. (Knapp-USGS)
W71-05051

BOTTOM DRIFT FOR THE SOLITARY WAVE,
Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.
Roland K. Price.
Journal of Geophysical Research, Vol 76, No 6, p 1600-1602, February 20, 1971. 3 p, 2 fig, 2 ref.

Descriptors: *Waves (Water), *Littoral drift, Shores, Beaches, Currents (Water), Water circulation, Sediment transport, Bed load.
Identifiers: Bottom drift (Water waves).

The drift of a fluid particle on the bottom of a channel of uniform depth (h) is calculated for the passage of a solitary wave. The magnitude of the drift for the solitary wave of maximum amplitude is 1.70 h. (Knapp-USGS)
W71-05056

TRACE ELEMENT AND ORGANIC CARBON ACCUMULATION IN THE MOST RECENT SEDIMENTS OF SOUTHERN LAKE MICHIGAN,
Illinois State Geological Survey, Urbana.
N. F. Shimp, J. A. Schlekher, R. R. Ruch, D. B. Heck, and H. V. Leland.
Illinois Geological Survey Environmental Geology Notes, No 41, January 1971. 25 p, 18 fig, 3 tab, 5 ref.

Descriptors: *Bottom sediments, *Sediments, *Trace elements, *Carbon, *Lake Michigan, *Data collections, Sampling, Chemical analysis, Cores, Clays, Evaluation.
Identifiers: *Recent sediments, Tables of data.

Trace elements were determined in 21 grab samples and in sections of 21 cores collected from southern Lake Michigan. In all, 119 sediment samples were analyzed for 13 trace elements, organic carbon, and clay. Bromine, chromium, copper, lead, and zinc are concentrated in the uppermost, or recently deposited, portions of organic-rich, fine-grained, southern Lake Michigan sediments. High concentrations of these elements correlate more closely with the amounts of organic carbon present than with clay-size material, water depth, iron oxide, or manganese oxide. Off major river mouths, trace elements have accumulated to greater depths within the sediments in deeper regions of the lake, which is probably a result of high depositional rates associated with the rivers' large sediment load. Trace elements showing little or no accumulation in the recently deposited sediments are beryllium, boron, cobalt, lanthanum, manganese, nickel, scandium, and vanadium. (Woodard-USGS)
W71-05064

GEOLOGY AND HYDROLOGY OF SELECTED PLAYAS IN WESTERN UNITED STATES.
Massachusetts Univ., Amherst. Dept. of Geology.

Available from NTIS as AD-709 683 - $3.00 in paper copy, $0.95 in microfiche. Massachusetts University, Geology Department, Final Scientific Report (Part II), to Air Force Cambridge Research Laboratories (AFCRL-69-0214), May 1970. 286 p. Contract AF 19 (628)-2486.

Descriptors: *Playas, *Sedimentation, Lake basins, Geomorphology, Deserts, Evaporation, Hydrogeology, Particle size, Climates, Weather, Surface waters, Groundwater, California, Nevada, New Mexico, Utah, Oregon, Arizona, Groundwater movement, Discharge (Water), Groundwater basins.
Identifiers: *Western U.S.

About 125 playas studied in the western United States can be divided into 'coarse-grained playas'. The 'fine-grained playas' are characterized by: (1) deposits of silts and clays, (2) slow artesian and capillary movement of water through the surface, (3) mostly smooth, hard surfaces, and (4) formation of giant desiccation polygons. The 'coarse-grained playas' are characterized by: (1) deposits of sand, silt, and evaporites, (2) rapid capillary discharge, (3) a water table nearly at the surface, and (4) soft surficial sediments. On playa surfaces, capillary discharge produces puffy ground, and the surface-water flooding produces smooth, hard ground. Capillary discharge combined with deposition of mud from floods with roots and water-transported plants produces highly irregular knobby ground in some playas. Playas change over many years because of long-term changes in the environment and over a period of days or months because of short-term changes in the environment and over a period of days or months because of short-term changes in weather and precipitation. Many playas have grown in recent years at the expense of adjacent desert flats. (See also W71-05074 thru W71-05080) (Knapp-USGS)
W71-05073

GEOLOGY AND HYDROLOGY OF ROGERS PLAYA AND ROSAMOND PLAYA, CALIFORNIA,
Massachusetts Univ., Amherst. Dept. of Geology; and Mobil Oil Corp., Shreveport, La.
Ward S. Motts, and David Carpenter.
In: Geology and Hydrology of Selected Playas in Western United States, Massachusetts University, Geology Department, Final Scientific Report (Part II) to Air Force Cambridge Research Laboratories (AFCRL-69-0214) Chapter 2, p 23-65, May 1970. 43 p, 25 fig, 7 ref.

Descriptors: *Playas, *Sedimentation, Lake basins, Geomorphology, Deserts, Evaporation, Hydrogeology, Particle size, Climates, Weather, Surface waters, Groundwater, California, Nevada, New Mexico, Utah, Oregon, Arizona, Groundwater movement, Discharge (Water), Groundwater basins.
Identifiers: *Western U.S.

Five major playa-surface types were observed on Rogers Playa and Rosamond Playa, California: (1) a surface of 'mud curls' or fragments of concave-upward mud polygons, (2) a smooth, hard, compact surface, (3) an irregular puffy surface with higher porosity than the smooth surface, (4) a transitional surface containing areas of both the smooth and the puffy surfaces, and (5) a generally smooth surface characterized by a white crust of salt and carbonate. The surface types changed from

year to year primarily because of surface-water floodings. Soil moisture contents of samples from test holes showed (1) a general downward increase of moisture in fine-grained sediments of the same size, (2) a decrease of moisture content where the sediments became more silty and sandy, and (3) a decrease of moisture in some clays and silts resting above sand zones. Increasing desiccation of the fine-grained deposits accompanied by the lowering of potentiometric levels has been an important factor in the continued formation of giant desiccation polygons on Rogers Playa. (See also W71-05073) (Knapp-USGS)
W71-05074

GEOLOGY AND HYDROLOGY OF COYOTE PLAYA,
Massachusetts Univ., Amherst. Dept. of Geology.
David J. Hagar.
In: Geology and Hydrology of Selected Playas in Western United States Massachusetts University, Geology Department, Final Scientific Report (Part II), to Air Force Cambridge Research Laboratories (AFCRL-69-0214) Chapter 3, p 66-107, May 1970. 42 p, 4 fig, 2 tab, 31 ref.

Descriptors: *Playas, *Sedimentation, Lake basins, Geomorphology, Deserts, Evaporation, Hydrogeology, Particle size, Climates, Weather, Surface waters, Groundwater, California, Nevada, New Mexico, Utah, Oregon, Arizona, Groundwater movement, Discharge (Water), Groundwater basins.
Identifiers: *Western U.S.

Coyote Lake, California occupies the central portion of a basin bounded on the north, west, and east sides by mountains of moderate relief and on the south side by a broad plain extending to the Mojave River. The areas surrounding the playa show evidence of a former, perennial lake. The lake sediments underlying the playa are very fine-grained and compact, and have clay contents as high as 87%. Changes of the playa surfaces result from moisture changes of the clays near the surface due to floodings of the playa. Most of the playa has a smooth, hard surface, but in some areas soft, dry, puffy surfaces occur. The extent and nature of these two surface types change with time. Although puffy surfaces commonly are associated with groundwater discharge on other playas, water from depth beneath Coyote Lake is supplying little moisture to the clays. The playa surface has giant desiccation fissures which intersect and form polygons ranging from 100 to 300 feet across. The majority are relict fissures, filled with sediment. The playa is not aggrading permanently, although material is brought to the playa during periodic flooding. The presence of loose, coarse detritus on the clay surface suggests that the fine materials are deflated. (See also W71-05073) (Knapp-USGS)
W71-05075

RESULTS OF TEST-DRILLING AND WINTER MAPPING PROGRAMS ON COYOTE PLAYA, CALIFORNIA,
Massachusetts Univ., Amherst. Dept. of Geology.
Ward S. Motts.
In: Geology and Hydrology of Selected Playas in Western United States, Massachusetts University, Geology Department, Final Scientific Report (Part II), to Air Force Cambridge Research Laboratories (AFCRL-69-0214), Chapter 3, Pt. 2, p 108-136, May 1970. 29 p, 10 fig, 7 ref.

Descriptors: *Playas, *Sedimentation, Lake basins, Geomorphology, Deserts, Evaporation, Hydrogeology, Particle size, Climates, Weather, Surface waters, Groundwater, California, Nevada, New Mexico, Utah, Oregon, Arizona, Groundwater movement, Discharge (Water), Groundwater basins.
Identifiers: *Western U.S.

In order to learn more about the sediments and the geomorphic processes operative on Coyote Playa, California, a rotary drilling and coring program was conducted in 1965 and 1966. Throughout the playa surface, capillary discharge of groundwater occurs from a shallow (10 to 25 foot) extensive zone of subsurface permeability, and capillary discharge combined with hydrostatic head occurs from deeper water-bearing beds below the playa clays. This capillary discharge may have an important influence on the surface morphology. Puffy ground and the wavy undulating surface may be formed wholly or in part from processes associated with groundwater discharge. (See also W71-05073) (Knapp-USGS)
W71-05076

RECONNAISSANCE GEOLOGY OF BIG SMOKY PLAYA, NEVADA,
Chevron Oil Co., Jackson, Miss.
Robert F. Walker, and Ward S. Motts.
In: Geology and Hydrology of Selected Playas in Western United States, Massachusetts University, Geology Department, Final Scientific Report (Part II), to Air Force Cambridge Research Laboratories (AFCRL-69-0214), Chapter 4, p 137-165, May 1970. 29 p, 13 fig, 2 tab, 13 ref.

Descriptors: *Playas, *Sedimentation, Lake basins, Geomorphology, Deserts, Evaporation, Hydrogeology, Particle size, Climates, Weather, Surface waters, Groundwater, California, Nevada, New Mexico, Utah, Oregon, Arizona, Groundwater movement, Discharge (Water), Groundwater basins.
Identifiers: *Western U.S.

Big Smoky Playa is in the southern part of Big Smoky Valley, Nevada. Well-developed shoreline encircle the playa, suggesting that the location of a Pleistocene lake (Lake Tonopah) influenced its size and shape. Surface types on Big Smoky Playa in 1965 ranged from a hard, smooth surface to a soft, puffy one. Several holes were augered beneath the transition surface, in one place to a depth of 20 feet; however, a water-bearing zone was not penetrated. No significant textural difference was found in the sediments underlying the puffy areas and the smooth hard areas. Groundwater discharge from a shallow aquifer controls the formation of puffy ground on Big Smoky Playa. The shallow aquifer consists of complex interfingering of permeable lenses of sand and coarse silt within the less permeable silt and clay. Water under hydrostatic head fills the sand-silt lenses and capillary flow from these lenses produces the puffy ground. (See also W71-05073) (Knapp-USGS)
W71-05077

GEOLOGY AND HYDROLOGY OF TROY PLAYA, SAN BERNARDINO COUNTY, CALIFORNIA,
Texas Univ., Austin. Bureau of Economic Geology.
Charles G. Groat.
In: Geology and Hydrology of Selected Playas in Western United States, Massachusetts University, Geology Department, Final Scientific Report (Part II) to Air Force Cambridge Research Laboratories (AFCRL-69-0214), Chapter 5, p 166-199, May 1970. 34 p, 13 fig.

Descriptors: *Playas, *Sedimentation, Lake basins, Geomorphology, Deserts, Evaporation, Hydrogeology, Particle size, Climates, Weather, Surface waters, Groundwater, California, Nevada, New Mexico, Utah, Oregon, Arizona, Groundwater movement, Discharge (Water), Groundwater basins.
Identifiers: *Western U.S.

Troy Playa is located in the southeast corner of the Lower Mojave Valley, an area formerly occupied by Lake Manix of late Pleistocene age. The upper 10 to 15 feet of playa sediments have two lithofacies: (1) an upper mud facies grading to sandy mud near the playa margins and (2) an underlying sand facies characterized by sand and muddy sand granular coarse sand in the upper few inches. The sand facies probably records fluvial and eolian deposition, whereas most of the mud was deposited in ephemeral playa lakes. Most of Troy Playa has a puffy surface produced by capillary discharge of shallow groundwater. A hard playa surface is present in the southwestern part of the playa where the water table is farther below the surface. Declining groundwater levels have resulted in a decrease in capillary discharge at Troy Playa which could foster a conversion from a puffy to a hard-compacted playa surface. Heavy pumpage and minimal recharge caused a decline in the potentiometric surface. The decline in areas of heavy pumpage west of the playa is resulting in intrusion of poor-quality water from the Troy Playa area into freshwater aquifers west of the playa. (See also W71-05073) (Knapp-USGS)
W71-05078

RECONNAISSANCE GEOLOGY OF CLAYTON PLAYA, NEVADA,
Shell Oil Co., Midland, Tex.
David B. Matz.
In: Geology and Hydrology of Selected Playas in Western United States, Massachusetts University, Geology Department, Final Scientific Report (Part II) to Air Force Cambridge Research Laboratories (AFCRL-69-0214), Chapter 6, p 214-236, May 1970. 23 p, 12 fig, 7 ref.

Descriptors: *Playas, *Sedimentation, Lake basins, Geomorphology, Deserts, Evaporation, Hydrogeology, Particle size, Climates, Weather, Surface waters, Groundwater, California, Nevada, New Mexico, Utah, Oregon, Arizona, Groundwater movement, Discharge (Water), Groundwater basins.
Identifiers: *Western U.S.

Clayton Valley is the terminal discharging locality for deep water circulation throughout the Tonopah area of Nevada. Logs of closely-spaced test holes show disturbed and chaotic deposits which are characteristic of many terminal groundwater discharging playas. The large amount of groundwater and capillary discharge accompanied by deposition of salts has probably disrupted the bedding and lamination of sediments formed in the playa and playa-lake environment. Also by this process, silty mine tailings have been destroyed in the last 50 years. In some places high mineralization of groundwater is related to the formation of hard and soft irregular puffy ground. Near the center of the playa small areas of knobby-hard ground are formed around the accumulation of twigs, branches and roots carried into the playa by floods. (See also W71-05073) (Knapp-USGS)
W71-05079

SOME HYDROLOGIC AND GEOLOGIC PROCESSES INFLUENCING PLAYA DEVELOPMENT IN THE WESTERN PART OF THE BASIN AND RANGE PROVINCE, UNITED STATES,
Massachusetts Univ., Amherst. Dept. of Geology.
Ward S. Motts.
In: Geology and Hydrology of Selected Playas in Western United States, Massachusetts University, Geology Department, Final Scientific Report (Part II) to Air Force Cambridge Research Laboratories (AFCRL-69-0214), Chapter 7, p 237-286, May 1970. 50 p, 28 fig, 3 tab, 13 ref.

Descriptors: *Playas, *Sedimentation, Lake basins, Geomorphology, Deserts, Evaporation, Hydrogeology, Particle size, Climates, Weather, Surface waters, Groundwater, California, Nevada, New Mexico, Utah, Oregon, Arizona, Groundwater movement, Discharge (Water), Groundwater basins.
Identifiers: *Western U.S.

Surface morphology of most coarse-grained and many fine-grained playas is related to several factors, including the rate of capillary discharge and the frequency of surface-water flooding. Puffy ground is present where the rate of capillarity is relatively high and where relatively few floodings occur. A smooth surface is present where the capil-

lary rate is low or lacking and where a relatively large number of floodings occur. During winter many playas of the Mojave Desert are frequently flooded. Water on the playa shifted and moved in response to changes in wind direction. Silts and clays near the surface became saturated with water, thereby increasing their mobility. Geomorphic features on playas constantly change in response to short-term and long-term climatic fluctuations. Daily and monthly changes in microrelief are commonly caused by playa flooding and by seasonal climatic variations. Sediments deposited in the playas of the Mojave Desert are soon removed by wind erosion. (See also W71-05073) (Knapp-USGS)
W71-05080

MORPHOLOGY OF THE SLIMS RIVER,
New York State Univ. College, Fredonia.
Robert K. Fahnestock.
In: Icefield Ranges Research Project Scientific Results, Volume 1: American Geographical Society (New York) and Arctic Institute of North America (Montreal), p 161-172, 1969. 12 p, 7 fig, 4 tab, 20 ref. NSF Grant GP-2814.

Descriptors: *Channel morphology, *Sediment transport, *Glaciers, *Alluvial channels, Sediment load, Regime, Braiding, Geomorphology.
Identifiers: *Outwash, *Slims River (Canada).

The Alaska Highway crosses the Slims River at mile 1060 where in 1965 the river was building a delta into Kluane Lake. Kaskawulsh Glacier, 14 mi. upstream, was the source of much of the debris being deposited in the valley. The surrounding countryside is covered with loess derived from the valley train. The discharge of the Slims River ranged from 0 to 20,000 cfs. In an upstream zone, 1 to 3 channels were cutting down in coarse gravel on a slope lower than that of the intermediate zone. The river was multichanneled in the intermediate zone with considerable bed load transport and some deposition. At all stages it was channel and bar dominated. About mile 1.5 in the intermediate zone, the slope was 15 ft./mi. and at relatively high flows in July 1965, 30 channels covered nearly half of the 6000-ft.-wide valley floor. In the downstream zone at high stages the river had a few bars and graded into a sheet of flowing water. On sand, at mile 6.2 in the downstream zone, on a slope of 4.5 ft./mi. 20 channels covered nearly all of the 5700-ft.-wide valley floor. The stream was regrading the valley train. In 1967, the Kaskawulsh Glacier's contribution to the Slims River shifted subglacially to the Kaskawulsh River, imposing a new set of conditions on the valley train and Kluane Lake. Initial changes due to this shift include a major decrease in discharge of Slims River and an increase in amount of blowing sediment. (Knapp-USGS)
W71-05101

ON THE MICROSCOPIC DETERMINATION OF THE VOLUME SIZE DISTRIBUTION OF FINE-GRAINED SUSPENDED PARTICLES,
Johns Hopkins Univ., Baltimore, Md., Chesapeake Bay Inst.
For primary bibliographic entry see Field 07B.
W71-05107

MINERALOGY OF A PLAYA SOIL AND UNDERLYING SEDIMENTS FROM THE HIGH PLAINS MEDIUM-TEXTURED SOIL ZONE,
Texas Tech. Univ., Lubbock. Dept. of Soil Science.
Kenneth Ray Davis.
M Sc Thesis, Texas Tech University, December 1970. 109 p, 18 fig, 13 tab, 66 ref. OWRR Project B-004-TEX (1).

Descriptors: *Playas, *Sediments, *Soil types, *Texas, Sedimentation, Recharge, Geology, Mineralogy, Clay minerals, Soil classifications, Soil formation, Soil chemistry, Soil investigations, Soil physical properties, Permeability.
Identifiers: *Playa soils.

The primary objectives of this study were (1) to determine the mineralogy of a selected playa soil and its underlying sediments and (2) to determine the relationship of the sediments to the associated upland soils. The selected playa was located on native rangeland in eastern Hockley County, Texas. A soil mapped as Randall clay occupies the floor of the playa which seemed to be typical of the medium-textured soil zone. Appreciable natural recharge of playa water to the aquifer is unlikely because of the high amount of fine expanding clay in the playa soil. (Knapp-USGS)
W71-05112

THE ESTABLISHMENT OF VEGETATION ON NONTOPSOILED HIGHWAY SLOPES IN WASHINGTON,
Washington State Univ., Pullman. Agricultural Research Center.
For primary bibliographic entry see Field 04D.
W71-05147

2K. Chemical Processes

NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON, OHIO,
Agricultural Research Service, Beltsville, Md. Soils Lab.
For primary bibliographic entry see Field 05B.
W71-04856

STABLE CARBON ISOTOPES IN BLUE-GREEN ALGAL MATS,
Texas Univ., Port Aransas. Inst. of Marine Science; and Texas Univ., Port Aransas. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02L.
W71-04873

RADON IN GROUNDWATERS OF DOLOMITIC AND CALCAREOUS AQUIFER IN APULIA (SOUTHERN ITALY),
CNEN, Laboratory for the Application of Radioisotopes to Hydrogeology, Bari, and Bari Univ., Italy.
G. Magri, and G. S. Tazioli.
In: Isotopes Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Engergy Agency STI/PUB/255, Paper No SM-129/53, p 835-845, 1970. 11 p, 6 fig, 12 ref.

Descriptors: *Radioisotopes, *Tracers, *Hydrogeology, *Karst, Aquifers, Limestones, Dolomites, Saline water intrusion, Groundwater movement, Water circulation, Water chemistry, Water wells, Springs, Sampling, Water analysis, On-site tests.
Identifiers: *Radon, *Italy.

The Mesozoic limestones and dolomites forming the basement of the whole of Apulia, Italy are a huge natural groundwater reservoir with fresh water overlying intruding sea water. The radon content of these waters was determined by in-situ measurements of gamma activity of the decay products of radon, which was collected on activated carbon by filtering the water. Measurements were made on water from springs and from drilled and hand-dug wells in areas where the geological conditions are known. Where there are rock levels in which the radioactivity is higher than that normally encountered in the aquifer, the radon provides a natural tracer for following groundwater circulation. The radon contents are studied in relation to the water temperature and salinity, the natural gamma radioactivity of the rocks, carbon dioxide contents, and the filtration rate, using radioactive tracers and the borehole dilution technique. Where the natural radioactivity of the rocks is distributed evenly, a relationship was observed between the mobility of the groundwater and the radon content: in general, the greater the mobility, the higher the radon content. (Knapp-USGS)
W71-04884

SILICON-32 HYDROLOGY,
Tata Inst. of Fundamental Research, Bombay, India.
D. Lal, V. N. Nijampurkar, and S. Rama.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/54, p 847-868, 1970. 22 p, 5 fig, 5 tab, 26 ref.

Descriptors: *Radioactive dating, *Carbon radioisotopes, *Groundwater, *Hydrogeology, *Surface waters, Precipitation (Atmospheric), Mixing, Groundwater movement, Streamflow, Aquifers, Soil water.
Identifiers: *Silicon radioisotopes, *Groundwater dating.

Extensive studies of cosmogenic Si-32 activity in precipitation surface and sub-surface waters, rainwater, and rock/soil systems have established its usefulness for (1) dating groundwater younger than 2000 years and (2) checking the validity of C-14 ages between 2000 and 5000 years. If a concordant age is found based on both Si-32 and C-14 the deduced apparent age (irrespective of the model used) is in fact close to the 'true age' of the groundwater. However, if this is not so, it would be expected that a given water body will look younger on the basis of a shorter-lived radioisotope and that the 'true age' would be even greater than that obtained on the basis of the longer-lived isotope. Such a situation would result from mixing of old and young waters in the aquifer. Intercomparison of Si-32 and C-14 ages is valuable in the delineation of groundwater characteristics. (Knapp-USGS)
W71-04885

GEOCHEMISTRY OF LITHIUM IN THE SEDIMENTARY CYCLE,
Akademiya Nauk SSSR, Moscow. Institut Geokhimii i Analiticheskoi Khimii; and Moscow State Univ. (USSR). Dept. of Geochemistry.
A. B. Ronov, A. A. Migdisov, N. T. Voskresenskaya, and G. A. Korzina.
Translated from Geokhimiya, No 2, p 131-161, 1970. Geochemistry International, Vol 7, No 1, p 75-102, 1970. 28 p, 9 fig, 6 tab, 44 ref.

Descriptors: *Geochemistry, *Sedimentation, *Weathering, *Alkali metals, Distribution patterns, Trace elements, Leaching, Geology, Mineralogy, Sediment transport, Clays, Clay minerals.
Identifiers: *Lithium, USSR.

A large amount of data is surveyed to reveal the pattern of the geochemistry of lithium during weathering and deposition. This survey extends from the Riphean to the Quaternary in the Russian platform. Elution of Li predominates in the initial (alkaline) stage of weathering, while in the later (more acid) stages, the Li accumulates with Al in clay minerals. There are two main types of Li distribution in sedimentation. The first involves proportional deposition with Al in the aluminosilicate structures of clay minerals; it is the commoner during sedimentation and preserves the relations built up in the weathering crust. The second (rarer) type of Li distribution occurs in the sediments of salt lakes, where the Li accumulates along with Mg, SO3, and Cl, which are characteristic of sea water. The Li balance in the crust is discussed, and it is concluded that there is no substantial disturbance in the balance in the outer parts of the Earth. The bulk of the Li is concentrated in rocks of the continental crust. (Knapp-USGS)
W71-04893

DISTRIBUTION AND MIGRATION OF LEAD IN GROUND WATERS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).

For primary bibliographic entry see Field 05B.
W71-04894

BIOGEOCHEMICAL INVESTIGATIONS IN THE RUDNYY ALTAY,
Akademiya Nauk SSSR, Moscow. Institut Geokhimii i Analiticheskoi Khimii.
D. P. Malynga, and A. D. Ayvazyan.
Translated from Geokhimiya, No 3, p 364-371, 1970. Geochemistry International, Vol 7, No 2, p 269-276, 1970. 8 p, 4 tab, 11 ref.

Descriptors: *Geochemistry, *Trace elements, *Iron, *Sulfates, *Surveys, Exploration, Soil water, Vegetation effects, Bioindicators, Mining.
Identifiers: *Biogeochemistry, *Ore deposits, *USSR.

Areas with different conditions of migration of chemical elements have been outlined in the forest and steppe zones of the Rudnyy Altay, USSR. Geochemically anomalous landscapes are distinguished by relatively low pH of soil water and high content of SO4, Fe, and trace elements such as lead, copper, zinc, molybdenum, and silver in soil and plants. The ratio of biological absorption is lower and ash content of plants higher over ore deposits than outside their boundaries. Plants over ore deposits are stunted and afflicted with chlorosis. Plants of the pink family flourish in areas with copper mineralization. These characteristics have been used in biogeochemical prospecting in the Rudnyy Altay. (Knapp-USGS)
W71-04895

GEOCHEMICAL TRENDS IN THE OCCURRENCE AND MIGRATION FORMS OF GOLD IN NATURAL WATER,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
G. A. Goleva, V. A. Krivenkov, and Z. G. Gutz.
Translated from Geokhimiya, No 6, p 744-757, 1970. Geochemistry International, Vol 7, No 3, p 518-529, 1970. 12 p, 5 fig, 6 tab, 15 ref.

Descriptors: *Water chemistry, *Gold, *Solutes, Ion transport, Geochemistry, Inorganic compounds, Organic compounds, Sampling, Hydrogen ion concentration, Oxidation-reduction potential.
Identifiers: USSR.

Field studies and calculations show that pH and Eh affect the content and form of transport of gold in natural waters. Transport as chlorides is possible only in rarely encountered strongly acid HCl waters (pH less than 1, Eh greater than 0.8V). Weakly acid and alkaline aureole waters of sulfide deposits (pH greater than 6.5, Eh less than 0.5 V) in the presence of thiosulfates give rise to the very stable Au (S2O3)2 (3-). Gold forms not only inorganic compounds but also organic ones. Groundwaters from the surface or small depths in gold-ore deposits with high filtration rates transport gold mainly in colloidal and finely divided forms. (Knapp-USGS)
W71-04896

THE EFFECT OF SELECTED HYDROLOGIC VARIABLES ON STREAM SALINITY,
Agricultural Research Service, Chickasha, Okla. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02A.
W71-04897

A CONTRIBUTION TO THE ECOLOGY OF PLANARIA IN RUNNING WATERS. OBSERVATIONS MADE IN THE LANGUEDOC MEDITERRANEAN AREA; A STUDY OF THE CARBONIC ACID FACTOR, (IN FRENCH),
Montpellier Univ. (France). Lab. of Zoology.
Pierre Alause.
English abstract. Bulletin de la Societe Zoologique de France, Vol 94, No 2, p 223-228, 1969.

Descriptors: *Animal physiology, *Carbon dioxide, Streams, Ecology, Tubificids, Metabolism.
Identifiers: Carbonic gradient, Planaria.

This summary of a thesis is concerned with the influence of carbon dioxide on life activity of stream-inhabiting Planariidae: Dugesia gonocephala, D subtentaculata, D tigrina, and Polycellis felina. The well-being of these turbellarian worms is influenced by the dissolved carbon dioxide as much as it is by temperature and water oxygenation. The carbon dioxide is believed to be at the origin of chemotropism and favors the sensory-motor activity, metabolism, growth, sexual maturation, and an increased longevity. (Wilde-Wisconsin)
W71-04964

SPECIFIC CONDUCTANCE AS A MEANS OF ESTIMATING IONIC STRENGTH,
Geological Survey, Menlo Park, Calif.
Carol J. Lind.
For sale by Superintendent of Documents, US Goverment Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D272-D280, 1970. 9 p, 6 fig, 8 tab, 20 ref.

Descriptors: *Conductivity, *Electrical conductance, *Electrolytes, Aqueous solutions, Electrochemistry, Ions, Saline water, Saline water systems, Water analysis, Water properties, Water chemistry.
Identifiers: *Specific conductance-Ionic strength relations, Specific conductance, Ionic strength.

In an aqueous solution each cation-anion combination has its own characteristic curve on a plot, made on a log-log scale, of ionic strength versus conductance. If the major ionic combinations are known for a particular salt solution or natural-water source, ionic strength can be estimated from such a plot of these major cation-anion combinations. If, on the basis of previous periodic analyses, the ionic composition has only dilution as the main variable, then a characteristic plot may be made for that salt solution or natural-water source and used for future estimations of its ionic strength. (Knapp-USGS)
W71-04975

ANALYSIS OF WATER TEMPERATURE VARIATIONS IN LARGE RIVER,
Illinois State Water Survey, Peoria.
Veerasamy Kothandaraman.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 97, No SA 1, Paper 7908, p 19-31, February 1971. 13 p, 4 fig, 8 tab, 9 ref, append.

Descriptors: *Water temperature, *Fourier analysis, *Streamflow, *Variability, Illinois, Rivers, Seasonal, Statistical methods, Water quality, Cooling water, Thermal powerplants, Weather, Humidity.
Identifiers: Illinois River.

The seasonal variations in daily mean river water temperatures and daily mean dry bulb temperatures are adequately represented by harmonics with a periodicity of 1 year. Harmonics with a frequency higher than 1 cycle per yr contribute very little toward the seasonal variations. In the Illinois River nonseasonal variations in the daily mean water temperatures for any given day can be obtained, as a linear combination of the nonseasonal variations in the daily mean dry bulb temperatures, for that day and the preceding 2 days. (Knapp-USGS)
W71-05048

CARBON DIOXIDE EXCHANGE AT THE AIR-SEA INTERFACE: FLUX AUGMENTATION BY CHEMICAL REACTION,
Illinois Univ., Urbana. Dept. of Chemical Engineering.
J. A. Quinn, and N. C. Otto.
Supported in part by a grant from Office of Saline Water. Journal of Geophysical Research, Vol 76, No 6, p 1539-1549, February 20, 1971. 11 p, 3 fig, 26 ref.

Descriptors: *Carbon dioxide, *Air-water interfaces, *Sea water, *Water chemistry, Ion transport, Diffusion, Mass transfer, Hydrogen ion concentration, Hydration, Dehydration.
Identifiers: Carbon-dioxide flux.

The stagnant film model for the transport of CO2 across the air-sea interface is reexamined. By incorporating the constraint of electroneutrality, equations are derived to describe the flux of the carbon containing species within the film. The assumption of electroneutrality obviates the incorrect assumption of constant pH implicit in previous exchange calculations. Numerical results for typical ocean conditions indicate that for film thicknesses less than about 400 microns, oceanic exchange is not influenced by the hydration/dehydration reactions of dissolved carbon dioxide. However, if suitable catalysts are present in the ocean, the accelerated reactions are capable of augmenting the exchange rate by a considerable amount. The extent of this enhancement can be predicted by the model presented. (Knapp-USGS)
W71-05053

GEOLOGIC SIGNIFICANCE OF THE MINOR-ELEMENT COMPOSITION OF MARINE SALT DEPOSITS,
Geological Survey, La Jolla, Calif.
George W. Moore.
Economic Geology, Vol 66, No 1, p 187-191, January-February 1971. 5 p, 1 fig, 2 tab, 29 ref.

Descriptors: *Water chemistry, *Chemical precipitation, *Salts, *Trace elements, Sodium chloride, Evaporation, Mineralogy, Paleohydrology.
Identifiers: *Evaporites.

Detailed chemical analyses of marine halite rock ranging in age from Cambrian to Holocene are compared. If evaporite deposites reflect the geologic history of sea water, then a similar composition of rock salt of differing ages suggests that the ratio between ions in sea water has remained approximately constant since Cambrian time. Some elements, such as strontium and boron, are depleted in marine halite rock because they are deposited respectively earlier and later in the evaporation sequence. Lead is enriched a thousandfold, possibly because of heavy-metal concentration by microorganisms. (Knapp-USGS)
W71-05057

A PALEOHYDROLOGIC MODEL FOR MINERALIZATION OF THE WHITE PINE COPPER DEPOSIT, NORTHERN MICHIGAN,
Geological Survey, Beltsville, Md.
For primary bibliographic entry see Field 02H.
W71-05058

VAPOR-DOMINATED HYDROTHERMAL SYSTEMS COMPARED WITH HOT-WATER SYSTEMS,
Geological Survey, Menlo Park, Calif.
D. E. White, L. J. P. Muffler, and A. H. Truesdell.
Economic Geology, Vol 66, No 1, p 75-97, January-February 1971. 23 p, 7 fig, 6 tab, 58 ref.

Descriptors: *Geothermal studies, *Thermal water, *Steam, *Water vapor, *Hydrogeology, Groundwater movement, Mass transfer, Ion transport, Heat flow, Water temperature, Geysers, Water levels, Water table.
Identifiers: *Hydrothermal systems.

Vapor-dominated 'dry-steam' geothermal systems are uncommon and poorly understood compared with hot-water systems. Critical physical data on both types were obtained from U.S. Geological Survey research in Yellowstone Park. Vapor-dominated systems require relatively potent heat supplies and low initial permeability. After an early hot-water stage, a system becomes vapor dominated when net discharge starts to exceed recharge. Steam then boils from a declining water

table; most condenses below the surface, where its heat of vaporization can be conducted upward. Liquid water favors small pores and channels because of its high surface tension relative to that of steam. Steam is largely excluded from smaller spaces but greatly dominates the larger channels and discharge from wells. With time, permeability of water-recharge channels, initially low, becomes still lower because of deposition of carbonates and CaSo4. The 'lid' on the system consists in part of argillized rocks and CO2 saturated condensate. Local supply of pore liquid and a great stored heat of solid phases account for the physical characteristics and the high productivity of steam wells. Vapor-dominated systems provide a good mechanism for separating volatile mercury from all other metals of lower volatility. Mercury is likely to be enriched in the vapor of these systems; the zone of condensation that surrounds the uniform reservoir is attractive for precipitating HgS. (Knapp-USGS)
W71-05059

TRACE ELEMENT AND ORGANIC CARBON ACCUMULATION IN THE MOST RECENT SEDIMENTS OF SOUTHERN LAKE MICHIGAN,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 02J.
W71-05064

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1965, PARTS 12-16.
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W71-05089

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART II. PACIFIC SLOPE BASINS IN CALIFORNIA - VOLUME I.
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W71-05090

O-18/O-16 RATIOS IN SNOW AND ICE OF THE HUBBARD AND KASKAWULSH GLACIERS,
Calgary Univ. (Alberta). Dept. of Geology; and Calgary Univ. (Alberta). Dept. of Physics.
For primary bibliographic entry see Field 02C.
W71-05099

OCEANIC CO2 SYSTEM: AN EVALUATION OF TEN METHODS OF INVESTIGATION,
Oregon State Univ., Corvallis. Dept. of Oceanography.
P. Kilho Park.
Limnology and Oceanography, Vol 14, No 2, p 179-186, March 1969. 8 p, 3 fig, 1 tab, 20 ref. NSF Grant GA-1281; ONR Research Contract Nonr 1286 (10).

Descriptors: *Water chemistry, *Sea water, *Carbon dioxide, *Hydrogen ion concentration, Carbonates, Bicarbonates, Equilibrium, Alkalinity, Chemical potential, Water analysis, Chemical reactions, Geochemistry, Aqueous solutions, Saline water systems.
Identifiers: Sea water chemistry.

By combining two or more of the parameters pH, carbonate alkalinity, total carbon dioxide, and partial pressure of carbon dioxide, six equations can be obtained to express the concentration of carbonic acid that include molecular carbon dioxide, ten equations for bicarbonate ion, and eleven equations for carbonate ion concentrations. When the present-day analytical precision and the normal oceanic variances of the above four parameters are considered, the pH-partial pressure of carbon dioxide combination is the most promising to study the oceanic CO2 system. (Knapp-USGS)
W71-05104

COLORIMETRIC DETERMINATION OF DISSOLVED OXYGEN AT LOW CONCENTRATIONS,
Washington Univ., Seattle. Dept. of Oceanography.
William W. Broenkow, and Joel D. Cline.
Limnology and Oceanography, Vol 14, No 3, p 450-454, May 1969. 5 p, 2 fig, 3 tab, 9 ref.

Descriptors: *Dissolved oxygen analyzers, *Dissolved oxygen, *Laboratory tests, *Water analysis, Chemical analysis, Instrumentation, Chemical reactions, Water chemistry.
Identifiers: *Winkler method, *Dissolved oxygen analysis.

Oxygen concentrations can be determined colorimetrically by measuring the absorption of ultraviolet light by the triiodide ion that is produced when Winkler reagents are added to the sample. Samples are drawn into syringes to eliminate contact with the atmosphere. Reagents similar to those used in the Winkler method are injected into the syringes, and iodine is released in proportion to the dissolved oxygen originally in the sample. (Knapp-USGS)
W71-05108

SPECTROPHOTOMETRIC DETERMINATION OF HYDROGEN SULFIDE IN NATURAL WATERS,
Washington Univ., Seattle. Dept. of Oceanography.
Joel D. Cline.
Limnology and Oceanography, Vol 14, No 3, p 454-458, May 1969. 5 p, 3 fig, 3 tab, 15 ref. NSF Grant GA-644.

Descriptors: *Hydrogen sulfide, *Water analysis, *Spectrophotometry, Colorimetry, Analytical techniques, Chemical analysis, Water chemistry, Laboratory tests, Instrumentation, Chemical reactions.
Identifiers: *Hydrogen sulfide analysis.

A new spectrometric method of determining H2S is applicable to natural waters containing 1-1,000 microgram-atoms/liter sulfide-sulfur (0.03-32 ppm) and is free of salt effects and temperature dependence. Except at concentrations of less than 1 microgram-atom/liter, Beer's law is followed. The concentrations of the sulfide solutions estimated gravimetrically were always within 2% of the titrated value at the 95% confidence level. (Knapp-USGS)
W71-05109

2L. Estuaries

ON THE TECTONIC AND MORPHOLOGIC CLASSIFICATION OF COASTS,
Scripps Institution of Oceanography, La Jolla, Calif.
For primary bibliographic entry see Field 02J.
W71-04869

A SIMULATION MODEL OF A COMPLEX RECURVED SPIT,
Nottingham Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 02J.
W71-04870

THE MULTIPLE CAUSALITY OF BARRIER ISLANDS,
Western Washington State Coll., Bellingham. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W71-04872

STABLE CARBON ISOTOPES IN BLUE-GREEN ALGAL MATS,
Texas Univ., Port Aransas. Inst. of Marine Science; and Texas Univ., Port Aransas. Dept. of Geological Sciences.
E. W. Behrens, and S. A. Frishman.
Journal of Geology, Vol 79, No 1, p 94-100, January 1971. 7 p, 3 fig, 15 ref. NSF Grant GA 911.

Descriptors: *Algae, *Stable isotopes, *Carbon, *Anaerobic bacteria, *Texas, Biodegradation, Tracers, Lagoons, Cyanophyta.
Identifiers: Baffin Bay (Tex).

Blue-green algal mats have accumulated for over 1,000 years in Kleberg Point Lagoon on the margin of Baffin Bay, Texas. Organic carbon produced within the mats is isotopically heavier than the carbon associated with bay sediments. The difference between bay and mat organic carbon is preserved in the older, buried sediments, and seems to be increased by fractionation associated with anaerobic bacterial decomposition of algal mat organic matter. (Knapp-USGS)
W71-04873

GLASSY OBJECTS IN TERTIARY DEEP-SEA CLAYS CORED BY THE DEEP SEA DRILLING PROJECT,
Scripps Institution of Oceanography, La Jolla, Calif.
For primary bibliographic entry see Field 02J.
W71-04874

MINERALOGY AND DIAGENESIS OF SOME SOUTH AFRICAN COASTAL AND MARINE CARBONATES,
Cape Town Univ., South Africa. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W71-04875

SAND WAVES IN THE SOUTHERN BIGHT OF THE NORTH SEA,
Rijkswaterstaat-Deltadienst, Hague 9netherlands).
For primary bibliographic entry see Field 02J.
W71-04876

A CLAY MINERAL INVESTIGATION OF SIX CORES FROM THE GULF OF MEXICO,
Research Council of Alberta, Edmonton; and Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 02J.
W71-04877

USE OF RARE-EARTH ELEMENTS AS TRACERS IN ESTUARIES,
Stanford Univ., Calif.
P. Kruger, and J. K. Channell.
Supported by U S Public Health Service. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/56, p 869-883, 1970. 15 p, 5 fig, 3 tab, 9 ref.

Descriptors: *Tracers, *Trace elements, *Stable isotopes, *Neutron activation analysis, Tracing techniques, Dispersion, Streamflow, Discharge measurement, Sampling.
Identifiers: *Rare-earth elements.

For large hydrology systems, such as estuaries, the method of stable-isotope tracing with post-sampling activation analysis shows much promise. The method retains the inherent sensitivity of radiation measurement without the concomitant chemical problems of dyes and radiation problems of radioisotope tracers. The rare-earth elements possess favorable nuclear, chemical, physical, and low natural abundance properties which make them suitable as a tracer for flow and dispersion studies in estuaries. Post-sample treatment of irradiation in a 10-kW nuclear reactor, radiochemical group separation, and gamma-ray spectroscopy yields detection limits of 1 ng for europium and 20 ng for lanthanum. Its use has been tested in the San Francisco Bay in which the background concentration of lanthanum is 180 ng/l and of europium and 12

ng/l. The method can be used for tracing hydraulic flow or for persistence studies of suspended solids or settleable solid components in the estuary. The method competes favorably in cost, especially as the scale of the system increases. As many as six rare-earth elements can be measured simultaneously. They can be used in conjunction with radioactive rare-earth elements to extend tracing time or dilution range when the total amount of radiotracer is limited. (Knapp-USGS)
W71-04886

COBALT AND TANTALUM TRACERS MEASURED BY ACTIVATION ANALYSIS IN SEDIMENT TRANSPORT STUDIES,
Inst. for Soil Fertility, Haren; Delft Hydraulics Lab.; and Reactor Inst., Delft, Netherlands.
A. J. de Groot, E. Allersma, M. de Briun, and J. P. W. Houtman.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/57, p 885-898, 1970. 14 p, 7 fig, 2 tab, 3 ref.

Descriptors: *Tracers, *Neutron activation analysis, *Cobalt, *Suspended load, *Estuaries, Trace elements, Silts, Clays, Tracking techniques, Dispersion, Streamflow, Discharge measurement, Sampling.
Identifiers: *Tantalum.

The origin and transport of fine-grained sediments in connection with siltation problems of harbors and navigation channels was studied using Co and Ta tracers and activation analysis. An element which does not occur in the sediment is fixed in the mud. At specified points throughout the water course sediment samples are taken to determine the marking element by activation analysis. The selection and successful application of tracers that can be measured by activation analysis depends on the sensitivity of detection, the natural occurrence of the relevant elements in the sediments under investigation, and the fixation capacity of the tracer to the various grain size fractions. Further, the influence of the added element on the sedimentation behavior of the mud in suspension and on the desorption properties must be considered. The fixation process of Co is restricted to sediments with special characteristics; Ta, however, can adhere tightly to any sediment. Tantalum also has the advantage that its natural content in sediments is very low. Large quantities (several percent by weight) can adhere to the sediment without changing the sedimentation properties to an appreciable extent. Hardly any losses occur during leaching experiments simulating natural conditions. A detailed treatment is given of the chemical aspects of the method, including the behavior of the elements used in the light of the general environmental processes of sediment constituents in deltaic systems. (Knapp-USGS)
W71-04887

A RECONNAISSANCE OF THE SANTEE RIVER ESTUARY, SOUTH CAROLINA,
Geological Survey, Columbia, S.C.
T. Ray Cummings.
South Carolina Water Resources Commission Report No 2, 1970. 96 p, 28 fig, 3 plate, 16 tab, 16 ref.

Descriptors: *Estuaries, *South Carolina, *Streamflow, *Water quality, Water resources, Hydrologic data, Data collections, Water resources development, Water management (Applied), Discharge (Water), Tides, Tidal effects, Density stratification, Salinity.
Identifiers: *Santee River Estuary (SC).

The chemical and physical characteristics of water of the Santee River estuary were studied in relation to tidal conditions and fresh-water inflow, and the suitability of water for use at different locations was determined as a basis for evaluating some of the effects of a proposed diversion of water from Lake Moultrie to the Santee River. Under normal conditions, releases of water from Lake Marion to the Santee River estuary are 500 to 600 cfs. On several days during April and May 1969, however, flood releases exceeded 40,000 cfs. A tidal discharge measurement made at mile 5.9 on the North Santee River showed a maximum flow of 18,500 cfs on the ebb tide, and a maximum flow of 18,500 cfs on the flood tide. At mile 7.0 on the South Santee River, a tidal discharge measurement showed a maximum flow of 14,500 cfs on the flood tide; on the ebb tide the maximum flow was estimated to be 15,800 cfs. Under flood conditions in April and May 1969, the Santee River estuary changed from a partially mixed to a highly stratified condition. As flood waters flushed salt water seaward, freshwater was observed below mile 5.0 on both the North and South Santee Rivers. Dissolved oxygen measurements, temperature measurements, and chemical analyses of water indicate that the quality of the water and the variations in quality are due to natural processes; only the occurrence of detergents and pesticides indicate cultural activity. Water of the North and South Santee Rivers at mile 14 and above is of excellent quality for most domestic, industrial, and agricultural uses. (Knapp-USGS)
W71-04908

PASSIVE MICROWAVE MEASUREMENTS OF SNOW, SOILS, AND OCEANOGRAPHIC PHENOMENA,
Aerojet-General Corp., El Monte, Calif. Space Div.
For primary bibliographic entry see Field 07B.
W71-04942

ON THE SEASONAL DISTRIBUTIONS OF TEMPERATURE AND SALINITY IN RHODE ISLAND SOUND,
Naval Underwater Systems Center, Newport, R.I.
David H. Shonting, and Gerald S. Cook.
Available from NTIS as AD-715 203, $3.00 in paper copy, $0.95 in microfiche. Reprinted from Limnology and Oceanography, Vol 15, No 1, p 100-112, Jan 1970. Rept No NUSC-TD-125, 15 Oct, 1970. 16 p, 9 fig, 1 tab, 11 refs.
Identifiers: *Oceanographic data, Temperature, *Sea water, Salinity, Hydrographic surveying, Thermoclines, Narragansett Bay, Rhode Island, Rhode Island Sound.

The temperature and salinity of Rhode Island Sound were measured between July 1963 and July 1964. A seasonal thermocline developed at mid-depth in spring and intensified through August. Early fall cooling and wind mixing rapidly destroyed the thermocline, rendering the water column practically isothermal by late October. The salinity patterns are more complex than those of temperature and are strongly influenced by seasonal variations in coastal runoff. Brackish water outflow from Narragansett Bay was traced as a salinity wedge as far as 20-30 km from the coast. The seasonal variation in thermal energy of the sound is estimated to be at least four orders of magnitude greater than the potential energy changes.
W71-04944

PARTICULATE ORGANIC MATTER IN KANEOHE BAY, OAHU, HAWAII,
Hawaii Inst. of Geophysics, Honolulu.
Frances Anne Steinhilper.
Available from NTIS as PB-195 806, $3.00 in paper copy, $0.95 in microfiche. Hawaii Institute of Geophysics Report HIG-70-24, Dec 1970. 53 p, 11 fig, 14 tab, 25 ref.
Identifiers: *Sea water, Organic compounds, *Bays Topographic features, Hawaii, *Organic wastes, Sea water, Carbon, Nitrogen, Particles, Carbonates, Sewage, Water analysis, Chlorophylls, Primary biological productivity, Phytoplankton, Theses, Kaneohe Bay, Oahu Island, Carbon budget.

During the 3-month period from March through May 1970, a study of particulate organic matter was undertaken in Kaneohe Bay. The Bay was divided into two basins on the basis of circulation and topography and eight stations along the length of the Bay were sampled at 5-meter intervals. Particulate organic carbon concentrations varied temporally, ranging at the sewer outfall from a high of 686 microgram/l to a low of 121 microgram/l. Concentrations were constant with depth and decreased with increasing distance from the sewer outfall. Particulate nitrogen displayed the same trends as particulate organic carbon, ranging in concentration from 117 microgram/l to 27 microgram/l at the outfall. Total organic carbon concentrations showed similar trends, decreasing from 1.6 to 0.7 microgram C/l, except at Station 2. At Station 2, high surface productivity, probably caused by increased dissolved organic concentrations, resulted in a total organic carbon concentration of 2.6 microgram/l. A carbon budget was calculated for the southern basin. Circulation and primary production were determined to be important factors in the high organic carbon concentrations in the Bay; sewage discharge and runoff were secondary sources. Sewage discharge is indirectly an important source of Bay carbon as the effluent's high nutrient content results in high productivity.
W71-04949

RESEARCH IN THE COASTAL AND OCEANIC ENVIRONMENT,
Delaware Univ., Newark.
William S. Gaither.
Available from NTIS as AD-714 853, $3.00 in paper copy, $0.95 in microfiche. Annual Status Report CMS-3M DO 28, Oct 1970. 18 p, 14 fig, 2 tab, 3 ref. ONR NR 388-096.
Identifiers: *Ocean waves, Beaches, *Seacoast, Protection, Transport properties, Deposits, Sedimentation, Continental shelves, Tides, Sensors, Damage, Structures, Erosion, Soils, Stabilization, Breakwaters, Tables, Deleware, New Jersey, Maryland, Beach erosion, Shore protection, Coastal engineering, Air water interactions, Remote sensing.

Progress during the first year of a multidisciplinary study of the coastal environment of a section of the Atlantic Sea Coast (Delaware and adjacent New Jersey and Maryland areas) is summarized. Included are field, laboratory, and theoretical investigations of sedimentary processes, coastal vegetation, tidal marsh soils, wave action and attenuation, air-sea interactions, geological history and marine biology. Correlation of ground observations with high altitude photographic imagery to provide a useful method for the remote characterization of such coastal regions is an important objective.
W71-04950

PRIORITY PROBLEMS AND DATA NEEDS IN COASTAL ZONE OCEANOGRAPHY. EARTH OBSERVATION SATELLITE PLANNING,
Virginia Inst. of Marine Science, Gloucester Point.
R. J. Byrne, J. L. Dupuy, E. J. Joseph, J. C. Mundy, Jr., and J. A. Musick.
Available from NTIS as N70 40772, $3.00 in paper copy, $0.95 in microfiche. NASA-CR-111779, Sept 70. 138 p. NASA Contract NASI-9461.
Identifiers: *Coastal ecology, *Earth resources technology satellites, *Mission planning, *Oceanography, Experimental design, Priorities, Remote sensors, Satellite observation.

Coastal zone oceanographic problems and data needs have been defined for an oceanographic satellite. Problems are based on national and coastal zone priorities. Descriptions of the problems discuss the data needs and the expected utility of remote measurement. Data needs and resolution requirements are specified for surface and satellite measurement. Remote measurables are numerically ranked and evaluated. An experiment in coastal zone oceanography is proposed for Earth Resources Technology Satellite (ERTS A). Coordination of the ERTS program with International Decade of Ocean Exploration (IDOE) is discussed.
W71-04952

SOME PECULIAR FEATURES OF THE HYDROCHEMICAL REGIME AND THE FAUNA OF MESOHALINE WATERS,
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Institut.
V. V. Khlebovich.
Marine Biology, Vol 2, No 1, p 47-49, 1968. 5 fig, 21 ref.

Descriptors: *Saline water-freshwater interfaces, *Mixing, *Sea water, Brackish water, Fresh water, Water chemistry, Salinity, Marine animals, Biological communities, Ecotypes, Water chemistry.
Identifiers: *Mesohaline waters, Oligohaline animals.

A close connection was observed between hydrochemistry of a mixture of marine water and fresh water and the existence of an eco-physiological barrier. This barrier with salinity between 0.5 and 0.8% serves as the division line between marine and fresh water fauna. (Wilde-Wisconsin)
W71-04959

ON THE NUTRITION AND METABOLISM OF ZOOPLANKTON. VII. SEASONAL SURVEY OF NITROGEN AND PHOSPHORUS EXCRETION BY CALANUS IN THE CLYDE SEA-AREA,
Marine Biological Association of the United Kingdom, Plymouth (England). Lab.; and Marine Biological Station, Millport (Scotland).
For primary bibliographic entry see Field 02I.
W71-04965

PRIMARY PRODUCTION MEASUREMENTS ON A NATURAL PLANKTON BLOOM,
Bedford Inst., Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 02I.
W71-04967

STATUS OF SALT-WATER ENCROACHMENT IN 1969 IN SOUTHERN NASSAU AND SOUTHEASTERN QUEENS COUNTIES, LONG ISLAND, NEW YORK,
Geological Survey, Mineola, N.Y.
Philip Cohen, and G. E. Kimmel.
For sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D281-D286, 1970. 6 p, 2 fig, 4 tab, 13 ref.

Descriptors: *Saline water intrusion, *Aquifers, *New York, Withdrawal, Path of pollutants, Water balance, Sea water, Water levels, Hydrogeology, Hydrologic data, Data collections, Monitoring, Water quality.
Identifiers: *Long Island (NY).

Chloride data obtained from 'outpost' wells and other wells in southern Nassau and southeastern Queens Counties, Long Island, N.Y., indicate that landward movement of a deep wedge of salty groundwater in the area has been minimal from 1960 to 1969. Significant changes in chloride content were noted in only 3 of 30 outpost wells. Chloride content of water from a well in southeastern Queens County increased from 34 mg/l in 1960 to 112 mg/l in 1969, as a result of intensive groundwater withdrawals in that county; chloride content in two wells in Nassau County increased from 8,520 to 11,000 mg/l and from 2,000 to 8,110 mg/l during the same period. These increases resulted from local heavy pumping near the zone of diffusion. No increase in chloride content was noted in water from the Lloyd aquifer, except where leaky casings permitted downward flow of salty water. (Knapp-USGS)
W71-04976

WATER MASSES AND GENERAL CIRCULATION OF THE GULF OF MEXICO,
Texas A and M Univ., College Station. Dept. of Oceanography.
Worth D. Nowlin, Jr.
Oceanology, Vol 6, No 2, p 28-33, February, 1971. 6 p, 15 fig.

Descriptors: *Water circulation, *Gulf of Mexico, *Thermal stratification, Currents (Water), Dissolved oxygen, Salinity, Oceanography, Water temperature.
Identifiers: Water masses.

It is possible to distinguish and identify the origins of vertically layered waters within the Gulf: the surface mixed layer, North American deep water, subtropical underwater, oxygen minimum water, Antarctic intermediate water, North American deep water, and the basin waters. A general circulation pattern consists of a clockwise Loop Current flowing from the Yucatan to the Florida Strait in the eastern Gulf, but no strong, semi-permanent currents in the western Gulf. Large current rings, or edies, form from the Loop Current. A well-defined pattern of winter flow contrasts with a highly variable summer pattern for the western Gulf. The flow is influenced greatly by bottom or lateral friction with the shelves and that the deep Gulf waters connect directly with the deep Atlantic water only through the Caribbean Sea. At depths shallower that 1,000 m, inflow to the Gulf is generally through Yucatan Strait; outflow is through the Florida Strait. (Knapp-USGS)
W71-05050

GEOLOGIC SIGNIFICANCE OF THE MINOR-ELEMENT COMPOSITION OF MARINE SALT DEPOSITS,
Geological Survey, La Jolla, Calif.
For primary bibliographic entry see Field 02K.
W71-05057

OCEANIC CO2 SYSTEM: AN EVALUATION OF TEN METHODS OF INVESTIGATION,
Oregon State Univ., Corvallis. Dept. of Oceanography.
For primary bibliographic entry see Field 02K.
W71-05104

OCEANIC HEAT CONTENT OFF OREGON: ITS VARIATIONS AND THEIR CAUSES,
Oregon State Univ., Corvallis. Dept. of Oceanography.
For primary bibliographic entry see Field 02E.
W71-05105

DISPOSAL OF TITANIUM DIOXIDE WASTE IN A STRATIFIED ESTUARY,
Norsk Institutt for Vannforskning, Blindern.
For primary bibliographic entry see Field 05D.
W71-05159

CAUSES OF OYSTER SPAT MORTALITY, CONDITIONS OF OYSTER SETTING BEDS, AND RECOMMENDATIONS FOR OYSTER BED MANAGEMENT,
Bureau of Commercial Fisheries, Milford, Conn. Biological Lab.
For primary bibliographic entry see Field 05C.
W71-05202

SUMMARY OF OUR PRESENT KNOWLEDGE OF THE PHYSICAL PROCESSES OF MIXING IN THE OCEAN AND COASTAL WATERS, AND A SET OF PRACTICAL GUIDELINES FOR THE APPLICATION OF EXISTING DIFFUSION EQUATIONS IN THE PREPARATION OF NUCLEAR SAFETY EVALUATIONS,
Atomic Energy Commission, Washington, D.C., AND Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Institute.
Akira Okubo, and D. W. Pritchard.
Report No NYO-3109-40, Chesapeake Bay Institute, The Johns Hopkins University, Baltimore, Maryland, Ref 69-1, September 1969. 159 p, 50 fig, 4 tab, 80 ref. USAEC Contract No. AT (30-1)3109.

Descriptors: *Mathematical models, Equations, Application methods, *Mixing, *Advection, *Diffusion, Radiation, *Distribution patterns, *Ocean circulation, Currents, Turbulent flow, *Estuaries, Estuarine environment.
Identifiers: Instantaneous sources, Continuous release, Deep ocean, *Coastal waters.

The physical processes of circulation and mixing in the ocean, coastal waters and estuaries are described. Environmental features of the sea in relation to advective and diffusive processes are summarized. Mathematical formulations for mixing processes and a set of guidelines for nuclear safety evaluations are presented. Radially symmetrical solutions and shear diffusion solutions for an instantaneous point source are taken as fundamental. The principle of superposition of the fundamental solution is used to formulate solutions for a variety of practical problems. Predictions with a radially symmetrical solution are made for horizontal distributions of radioactivity from instantaneous sources and evaluations of concentration distribution from continuous sources. Predictions with the shear-diffusion solutions are made for the shape variation of patch from an instantaneous small-sized source and for the concentration distribution of plume from a continuous source. Box models are also presented for evaluation of large scale mixing in oceans and estuaries. (Ensign-PAI)
W71-05324

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DIFFUSION AND REVERSE OSMOSIS THROUGH POLYMER MEMBRANES,
Princeton Univ., N.J. Frick Chemical Lab.
Gail R. Steiner, Robert F. Eaton, T. K. Kwei, and Arthur V. Tobolsky.
Available from NTIS as AD-714 899, $3.00 in paper copy, $0.95 in microfiche. Technical Report No 127, Oct 1970. 27 p, 5 fig, 3 tab, 16 ref. ONR NR 056-377.
Identifiers: *Osmosis, *Membranes, *Cellulose acetates, Osmosis, *Nylon, *Desalination, Membranes, Polymers, Diffusion, Water, Sodium chloride, Permeability, Reverse osmosis, Nylon 6, *Reverse osmosis desalination.

Theoretical and practical aspects of reverse osmosis and diffusion are reviewed and discussed, with special emphasis on methods of determining diffusion constants and permeation constants. Small scale osmosis experiments were designed to yield useful data applicable to reverse osmosis systems. Measurements were made of diffusion constants and permeation constants for both water and NaCl in two kinds of cellulose acetate and also in Nylon 6 membranes. The results compared very well with those found in the literature for reverse osmosis.
W71-04943

OPTIMIZATION OF A SINGLE EFFECT MULTI-STAGE FLASH DISTILLATION DESALINATION SYSTEM,
Illinois Univ., Urbana. Coordinated Science Lab.
Allen Kent Coleman.
Available from NTIS as AD-713 843, $3.00 in paper copy, $0.95 in microfiche. Report R-490, Sept 1970. 46 p, 7 fig, 4 tab, 13 ref. DAAB-07-67-C-0199.
Identifiers: *Desalination, *Distillation, Control, Optimization, Programming, Computers, Mathematical models, Salinity, Sea water.

Due to the necessity for chemically pretreating the saline input flow to a desalination plant, it is advantageous to recycle through the condensers a fraction of the brine leaving the plant to reduce the required saline input flow and thereby reduce pretreatment costs. Such a system is referred to as single effect or multieffect depending upon

whether it has one or multiple recycle loops each in series configuration. The model for the present analysis is of the single effect type. It is the purpose of the analysis to develop a reliable mathematical model for the process and to present it in a form compatible with optimization via dynamic programming. It is felt that such an approach has the advantage that given a certain demand on the system the designer can optimize his cost performance index without having to fix the number of flashing stages or the amount of product flashed in each stage. To test the model and the optimization of that model a 50 million gallon per day system has been chosen.
W71-05256

3B. Water Yield Improvement

INCREASES IN STREAMFLOW AFTER CONVERTING CHAPARRAL TO GRASS,
Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station.
Alden R. Hibbert.
Water Resources Research, Vol 7, No 1, p 71-80, February 1971. 10 p, 8 fig, 1 tab, 8 ref.

Descriptors: *Water yield improvement, *Arizona, *Weed control, *Chaparral, Range management, Trees, Watershed management, Evapotranspiration control, Rainfall-runoff relationships, Arid lands, Rainfall disposition, Water yield, Demonstration watersheds.
Identifiers: *Experimental watersheds.

Water yield has increased substantially on two small chaparral watersheds in central Arizona following brush control and conversion to grass. Winter precipitation is the major source of water yield. Summer rains begin in July and normally account for about one-fourth of the annual precipitation but generally have little effect on streamflow. When annual precipitation is less than 16 inches, increase in water yield resulting from treatment is likely to be less than 2 inches. However, the efficiency of the conversion for producing extra water improves with rainfall, at least up to 34 inches. At this amount of annual precipitation, the increase in flow may reach 12 inches or more, depending on seasonal distribution of the rain. (Knapp-USGS)
W71-04855

THE EXPERIMENTAL MODIFICATION OF LAKE-EFFECT WEATHER,
Cornell Aeronautical Lab., Inc. Buffalo, N.Y.
For primary bibliographic entry see Field 02B.
W71-04951

PROJECT SKYWATER, PROCEEDINGS: SKYWATER CONFERENCE IV OPTIMIZATION OF OPERATIONAL WEATHER MODIFICATION.
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.

Available from NTIS as PB-195 887, $3.00 in paper copy, $0.95 in microfiche. Bureau of Reclamation Report REC-OCE-70-56, May 21-22, 1968. 165 p.

Descriptors: *Weather modification, Precipitation (Atmospheric), Cloud modification, Decision making, *Research and development, Silver iodide, Investigations, *Meteoric water, Water resources, Instrumentation, Water utilization, Progress reports, Orographic clouds, Cloud physics, Cloud seeding, Orographic precipitation, Reviews.
Identifiers: USBR Research Contracts, Skywater Project.

The Bureau of Reclamation's Atmospheric Water Resources Program, called Project Skywater, is developing the capability to apply precipitation management techniques to the solution of our nation's water needs. Evolutionary processes leading toward the best precipitation management system require the identification and analysis of the many problems in weather modification. Optimization of operational weather modification is presented. The objectives of each research contract program and the procedures for meeting these objectives are given. Discussions of the balance between research and operations and the roles of educational, private, and Government institutions in weather modification, in general, and Project Skywater in particular, are summarized. A statistical summary of the opinions returned expressing the status of the present and future state of the art is included.
W71-04956

1968 FLORIDA CUMULUS SEEDING EXPERIMENT: NUMERICAL MODEL RESULTS,
National Oceanic and Atmospheric Administration, Miami, Fla. Experimental Meteorology Lab.
Joanne Simpson, and Victor Wiggert.
Monthly Weather Review, Vol 99, No 2, p 87-118, February 1971. 32 p, 32 fig, 13 tab, 34 ref. Bureau of Reclamation Contract 14-06-W-176.

Descriptors: *Cloud seeding, *Evaluation, *Florida, Mathematical models, Numerical analysis, Water yield improvement, Silver iodide, Statistical methods, Cloud physics, On-site tests, Weather modification.
Identifiers: Cloud seeding evaluation.

A one-dimensional numerical cumulus model was tested against data from a randomized seeding experiment made in South Florida in 1968. Fourteen GO clouds were studied. Nine were seeded by pyrotechnics with 1 kg of silver iodide each, while five were studied identically as controls. Various seeding subroutines and assumptions regarding the ice phase are compared. The experimental aircraft data are used to guide the modeling assumptions and to select the most realistic ones. Seedability and seeding effect correlate to 0.96 for seeded clouds in the three best models. A high correlation is found between seedability and radar-measured rainfall increase from seeding. Also, a high correlation is found between model predictions of the difference in precipitation fallout between seeded and control clouds and the measured rainfall differences, although the model predictions are much smaller in magnitude. A calculation is undertaken showing that coalescence within the cloud body on descent of the raindrops easily accounts for the discrepancy. The model predictions for each GO cloud are discussed in comparison with actual measurements on the cloud. The 1968 experiment was found to subdivide into two periods, one fair and one disturbed with quite different effects of seeding. The two periods and corresponding cloud behavior are compared. It is concluded that the disturbed period was less favorable for seeding because of higher unseeded cloud growth and strong wind shear. Implications of this result for future modeling efforts are discussed. (Knapp-USGS)
W71-05061

EVAPORATION REDUCTION WITH FLOATING GRANULAR MATERIALS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Lloyd E. Myers, and Gary W. Frasier.
Journal of the Irrigation and Drainage Division, Proceedings of ASCE, Vol 96, No IR4, Proc. Paper 7741, p 425-436, December 1970. 2 fig, 4 tab, 12 ref.

Descriptors: *Reservoir evaporation, *Evaporation control, *Chemcontrol, Water yield improvement, Water supply, Irrigation, Evaporation.
Identifiers: Reflective materials.

Investigations were conducted to determine the feasibility of reducing evaporation from open water surfaces with white, floating granular materials which cool the water by reflecting incoming shortwave radiation. Studies were conducted on buried 7.2-m diameter tanks where almost all energy exchange occurred through the water surface. Materials evaluated were calcium carbonate dust, silica sand, polystyrene beads, chopped styrofoam and perlite. Evaporation reduction for 1 week ranged from 21% for water repellent sand to 64% for chopped styrofoam. Authors conclude that floating granular materials are feasible for reducing evaporation of expensive water from open tanks or small reservoirs with reasonably steep banks. Costs, using presently available materials, will be around $1.00 per 1000 gal. saved. (Oleszkiewicz-Vanderbilt)
W71-05138

3E. Conservation in Industry

INDUSTRIAL USE OF SURFACE WATERS IN ILLINOIS,
Illinois State Water Survey, Peoria. Water Quality Section.
Donald H. Schnepper, and Ralph L. Evans.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, p 36-40. 3 tab, 5 ref.

Descriptors: *Industrial water, Boiler feed water, Cooling water, Industrial plants, Pre-treatment, Turbidity, Temperature, Illinois, *Water utilization, *Water uses.

Data has been accumulated through several investigations on surface water quantity, surface water sources and water quality in the state of Illinois. Information regarding the industrial use of surface waters was obtained by questionnaire and personal visits. The conclusions set forth in this presentation pertain to compilation of data from these investigations with particular emphasis on the most current investigation. (Ellis-Texas)
W71-05166

3F. Conservation in Agriculture

COST OF PUMPING IRRIGATION WATER IN ARIZONA: 1891 TO 1967,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
William E. Martin, and Thomas Archer.
Water Resources Research, Vol 7, No 1, p 23-31, February 1971. 9 p, 5 fig, 1 tab, 32 ref.

Descriptors: *Water costs, *Irrigation water, *Pumping, *Arizona, Water sources, Water supply, Water management (Applied), Water distribution (Applied), Water levels, Drawdown, Water table, Aquifers, Alluvium, Data collections.
Identifiers: *Irrigation water cost (Ariz).

The historical record of the cost of pumping groundwater in Arizona is examined. Measures used are the cost per acre-foot per foot of lift, the cost per acre-foot, the water cost per acre for important crops, and the total water cost per farm for representative general crop farms. Costs are presented in actual dollars and dollars adjusted by GNP implicit price deflators. Whereas pumping depths have been rising rapidly, costs per acre-foot per foot of lift have been falling, adjusted costs per acre-foot have been almost constant, and per acre costs and total costs relative to both total costs and total returns have fluctuated throughout the time period examined, sometimes being lower but often being higher than costs at the present time. (Knapp-USGS)
W71-04851

ECONOMIC ANALYSIS OF WATER USE IN ILLINOIS AGRICULTURE,
Illinois Univ., Urbana. Dept. of Agricultural Engineering; and Illinois Univ., Urbana. Water Resources Center.
For primary bibliographic entry see Field 06B.
W71-04935

EVAPORATION LOSSES IN SPRINKLER IRRIGATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering; and Florida Univ., Gainsville. Water Resources Research Center.
For primary bibliographic entry see Field 02D.
W71-04938

FIFTEENTH ANNUAL WATER CONFERENCE.
New Mexico State Univ., University Park. Water Resources Research Inst.
For primary bibliographic entry see Field 04B.
W71-05065

IRRIGATION WATER REQUIREMENTS FOR CROP PRODUCTION IN THE ROSWELL ARTESIAN BASIN,
New Mexico State Univ., University Park. Dept. of Agricultural Economics and Agricultural Business.
For primary bibliographic entry see Field 04B.
W71-05066

IRRIGABILITY CLASSIFICATION OF NEW MEXICO LANDS,
New Mexico Agricultural Experiment Station, University Park.
For primary bibliographic entry see Field 04B.
W71-05068

SOIL AND WATER CONSERVATION NEEDS INVENTORY, COOKE, GRAYSON AND FANNIN COUNTIES, TEXAS.
Texoma Regional Planning Commission, Tex.

Available from NTIS as PB-195 447, $3.00 in paper copy, $0.95 in microfiche. Texoma Regional Planning Commission report, Aug 1970. 47 p. HUD Project Tex P-285.
Identifiers: *Regional planning, *Texas, *Soil conservation, Regional planning, *Water conservation, Inventories, Land use, Watersheds, Forest land, Grasses, Cultivation, Floods, Soils, Irrigated land, Maps, Tables, Data, Cooke County (Tex), Grayson County (Tex), Fannin County (Tex).

The inventory includes basic data that show the kind of soil, slope, erosion and land use characteristics in Cooke, Grayson and Fannin Counties. The land use classifications are separated into cropland, pastureland, rangeland, forest and woodland and 'other'. The acreages needing treatment in the various classification are described and the treatment that is feasible for this particular soil deficiency is outlined. Forest and woodlands needing establishment, improvement, protection or windbreaks are also described. All watersheds are delineated showing the problems with flooding and conservation of water along with project actions required to solve these problems.
W71-05150

SPRAY IRRIGATION-A POSITIVE APPROACH TO PERPLEXING PROBLEM,
Oxford Paper Co., West Carrolton, Ohio.
For primary bibliographic entry see Field 05D.
W71-05165

RECLAMATION AND IRRIGATION OF LANDS BY FEDERAL GOVERNMENT.
For primary bibliographic entry see Field 06E.
W71-05188

IRRIGATION FROM UPSTREAM WATERSHED RETENTION RESERVOIRS IN OKLAHOMA,
Economic Research Service, Washington, D.C.
Gordon R. Sloggett.
Oklahoma Agricultural Experiment Station, Progress Report P-631, April 1970. 19 p, 1 fig, 12 tab, 4 ref.

Descriptors: *Reservoir storage, *Watersheds (Basins), *Detention reservoirs, *Irrigation efficiency, *Oklahoma, Water conservation, Water management (Applied), Multiple-purpose reservoirs, Farm management, Investment, Irrigation systems, Irrigation practices, Income analysis, Irrigated land, Flood irrigation, Unit costs, Flood protection, Benefits, Net income, Sprinkler irrigation, Corp production, Surveys, Retention.
Identifiers: *Washita River Basin (Oklahoma), *Upstream reservoirs, Wheel move sprinkler, Skid move sprinkler, Boom irrigation.

Over 1,400 detention reservoirs were constructed in Oklahoma by the Soil Conservation Service since 1948. Farmers may use water stored in the sediment pool portion of reservoirs for irrigation. This study determined the number of farmers irrigating from upstream reservoirs; number, types and amount of investment of reservoirs and irrigation systems; and estimated income changes resulting from such irrigation. In 1969 upstream irrigators were interviewed. Largest concentration of irrigators was in the Washita River Basin from western to south-central Oklahoma. About 5,367 acres were irrigated from 89 reservoirs by 92 farmers in 1969. Irrigation systems included hand move sprinkler, flood, wheel move sprinkler, skid move sprinkler, and boom. Number of systems irrigating total acres and total cost were: 72, 4,087, $338,615; 11,658, $64,490; 4, 125, $29,300; 3, 332, $20,600; 2, 165; and $15,000, respectively. Per-acre irrigated cost varied from $62.05 for skid move sprinkler to $234.40 for wheel move sprinkler. Income increased as an unplanned benefit of flood protection. The average farmer irrigating from upstream detention increased his annual net income by over $1,691. Twelve tables give economic data on detention-reservoir irrigation. (Popkin - Arizona)
W71-05197

SELECTION AND MANAGEMENT OF IRRIGATED PASTURE MIXTURES,
Agricultural Research Service, Denver, Colo, and Montana Agricultural Experiment Station, Bozeman. Huntley Branch; and Montana Agricultural Experiment Station, Bozeman. Northwestern Branch.
C. S. Cooper, D. E. Baldridge, and C. W. Roath.
Montana Agricultural Experiment Station, Bulletin 622, February 1969. 22 p, 5 fig, 10 tab, 14 ref.

Descriptors: *Pasture management, *Forage mixtures, *Water management (Applied), *Water conservation, *Planning, Grasses, Legumes, Montana, Livestock, Planting management, Irrigated lands, Soil-water-plant relationships, Pastures, Grazing, Limiting factors, Farm management, Crop production, Labor, Unit costs, Evaluation, Economic prediction, Growth rates, Water demand, Varieties.
Identifiers: Weight gains.

There are an estimated 5 million acres of irrigated pasture in the western U.S., 10 percent of which occurs in Montana and is a major forage source for livestock. Irrigated pasture-mixture management is complex because multiple species have different and competing growth requirements. A discussion of management principles and description of major species and mixture factors are presented. Kentucky bluegrass, orchardgrass, smooth bromegrass and tall fescue are common on irrigated, well-drained soils. Six legumes--white clover, red clover, birdsfoot trefoil, alfalfa, alsike clover, and strawberry clover are recommended for irrigated pasture. Soil-water-plant relationships are discussed. Important considerations are: (1) more animals can be grazed than on range per unit land; (2) irrigated pasture produces good weight gains; (3) irrigated pastures on ranches with limited range may permit a better forage; (4) farm-management programs must be geared to forage as it is produced; (5) grass and legume mixtures yield highest production; (6) irrigated-pasture labor requirements are higher per cow than on range; (7) irrigated-pasture forage costs more per unit than range forage. Irrigated pastures are highly productive and may permit a profitable enterprise. Figures and tables show production and economic data on forage species and combinations. There are 14 references. (Popkin-Arizona)
W71-05198

AN ECONOMIC APPRAISAL OF DEVELOPING THE HARDIN UNIT FOR IRRIGATION,
Montana State Univ., Bozenes. Dept. of Agricultural Economics.
Ralph E. Ward, and Clarence W. Jensen.
Montana Agricultural Experiment Station, Bulletin 639, March 1970. 34 p, 4 fig, 10 tab, 18 ref.

Descriptors: *Comparative productivity, Appraisals, *Benefits, *Land management, *Land development, Irrigation programs, Properties, Capital costs, Drainage engineering, Irrigation systems, Water management (Applied), Social values, Indirect benefits, Grazing, Dry farming, Economic prediction, Economic impact, Economic efficiency, Montana.
Identifiers: *Hardin irrigation unit, *Crow Indian Reservation, *Missouri River Basin Project, Ownership, Trustland, Semiarid lands.

The Hardin irrigation unit, proposed by the Bureau of Reclamation for use on the Crow Indian Reservation, Montana, is evaluated. The unit would make the land part of the Missouri River Basin Project. The value of irrigated agriculture would be about 4 times the amount now obtained by dryland and grazing. There would be substantial indirect benefits from increased business activity, employment opportunities, processing plants, and social benefits such as stabilization, reduced unemployment, more facilities for education, transportation and electricity. Local industrial development would be supplemented. Proposed farm units would cut across ownership, trust and fee boundaries to create ownership and trustland problems. Predevelopment requires land leveling, layouts on irrigation systems, fields and drainage because Indian landowners cannot make capital improvements. Several land control and management plans are proposed: (1) form a non-profit leasing organization for development and maintain present ownership; (2) change ownership to conform to irrigated farm units; (3) develop leasing and private corporations for development and management. Any of these plans require a high degree of cooperation. A special educational and promotional program emphasizing benefits and requiring local sponsorship with technical assistance is necessary. (Popkin - Arizona)
W71-05200

CONSUMPTIVE IRRIGATION REQUIREMENTS FOR CROPS IN IDAHO,
Idaho Univ., Moscow. Dept. of Agricultural Engineering; and Idaho Water Resource Board.
R. J. Sutter, and G. L. Corey.
Idaho Agricultural Experiment Station, Bulletin 516, July 1970. 97 p, 91 tab, 2 fig, 10 ref.

Descriptors: *Consumptive use, *Optimization, *Planning, *Decision making, *Farm management, Microclimatology, Water balance, Diversion, Crop production, Irrigation practices, Labor, Inter-basin transfers, Reservoirs, Irrigable land, Idaho, Water requirements.
Identifiers: *Blaney-Criddle formula, *Crop quality, Micrometeorology, Climatic factor, Empirical methods, Evaporimeter, Semiarid lands.

Estimates of irrigation requirements for Idaho's 2.2 million acres of highly suitable irrigable land are made for optimal planning projects, reservoir decisions, interbasin transfer, efficient use, and determination of irrigation method, design, schedule, cropping pattern, labor requirements, and farm efficiencies. Overirrigation is wasteful, and may decrease yields and lower crop quality. Irrigation requirements will establish reasonable diversion quotas under legal dispute. Estimates of consumptive use can be made by using water balance, micrometeorological, evaporimeter, and empirical methods. These approaches are evaluated. The

modified Blaney-Criddle formula assumes: (1) consumptive use is proportional to the climatic factor; (2) crops are not limited by inadequate water supply during the growing season; (3) factors other than temperature, percentage of daylight hours, and growing season are similar at all locations. Climatological and growing-season data from 42 Weather Bureau stations are calculated. Average annual consumptive and irrigation requirement for 11 crops for these 42 stations are presented. Ninety-one tables show irrigation efficiencies, peak uses, and probability data on consumptive irrigation requirements. (Popkin - Arizona)
W71-05201

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

NUMERICAL SIMULATION OF FLOOD WAVE MODIFICATION DUE TO BANK STORAGE EFFECTS,
Geological Survey, Washington, D.C.
George F. Pinder, and Stanley P. Sauer.
Water Resources Research, Vol 7, No 1, p 63-70, February 1971. 8 p, 6 fig, 14 ref.

Descriptors: *Simulation analysis, *Floods, *Bank storage, *Surface-groundwater relationships, Water levels, Mathematical models, Numerical analysis, Hydrograph analysis, Base flow, Channel morphology, Groundwater movement, Hydrographs, Unsteady flow, Alluvium, Allivial channels, Dynamic programming.
Identifiers: Flood waves.

The modification of a flood wave due to bank storage effects can be calculated by using numerical methods. The dynamic equations describing one-dimensional open channel flow and the equation for two-dimensional transient groundwater flow are solved simultaneously, coupled by an expression for flow through the wetted perimeter of the channel. Numerical experiments indicate that flood waves may be modified considerably by bank storage, particularly in the lower segments of a long reach, and that the degree of modification is influenced markedly by the hydraulic conductivity of the aquifer. (Knapp-USGS)
W71-04854

INCREASES IN STREAMFLOW AFTER CONVERTING CHAPARRAL TO GRASS,
Forest Service (USDA), Tempe, Ariz. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W71-04855

A COMPARATIVE STUDY OF CRITICAL DROUGHT SIMULATION,
California Univ., Los Angeles. Dept. of Engineering Systems.
A. J. Askew, W. W-G. Yeh, and W. A. Hall.
Water Resources Research, Vol 7, No 1, p 52-62, February 1971. 11 p, 1 fig, 5 tab, 6 ref. OWRR Project B-061-CAL (6).

Descriptors: *Simulation analysis, *Droughts, *Reservoir design, *Streamflow forecasting, *Synthetic hydrology, Runoff forecasting, Reservoir operation, Statistical methods, Rainfall-runoff relationships.
Identifiers: *Drought simulation.

A set of monthly streamflow records is generated and analyzed to give a set of synthetic critical periods. Some characteristics of these periods are derived, and the mean and standard deviation of their values are compared with the appropriate values for the historical critical period. This procedure is repeated with three characteristics for a number of different rivers by using a variety of generating techniques. A study of the results allows a comparison between the generating techniques in regard to both their cost in computer time and their ability to synthesize critical droughts comparable to those recorded historically. The results appear to be influenced by the relative aridity of the watershed and by the size of the reservoir considered. In addition, some general conclusions can be drawn regarding the advisability of using generated streamflow in studies of reservoir design and operation. (Knapp-USGS)
W71-04861

FLOW THROUGH A TAILINGS POND EMBANKMENT,
Bureau of Mines, Spokane, Wash., and Idaho Univ., Moscow.
For primary bibliographic entry see Field 08D.
W71-04862

LAW OF STREAM RELIEF IN HORTON'S STREAM MORPHOLOGICAL SYSTEM,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 02E.
W71-04866

A NEW METHOD OF DETECTING LEAKS IN RESERVOIRS OR CANALS USING LABELLED BITUMEN EMULSIONS (FRENCH),
CEA, Center of Nuclear Study of Grenoble, and Societe routiere Colas, Paris, France.
J. Molinari, J. Guizerix, and R. Chambard.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/47, p 743-760, 1970. 18 p, 11 fig, 6 ref.

Descriptors: *Tracers, *Reservoir leakage, *Canal seepage, *Tagging, *Emulsions, Groundwater movement, Soil water movement, Iodine radioisotopes, Bituminous materials, Seepage, Infiltration.
Identifiers: Leakage detection.

A method of detecting and localizing leaks in natural or artificial stored-water bodies such as lakes, canals, basins, reservoirs, or wells consists of injecting into the stored water an emulsion labelled with a radioactive tracer. The labelled emulsion is entrained into the leakage areas where emulsion particles separate from the water and accumulate. The distribution of these particles, which are proportional to the specific infiltration flow for structures with interstitial permeability, is then determined simply by measuring the radioactivity. Where the labelled emulsion is an emulsion of bitumen, the plastic properties of this product are useful in promoting the agglomeration of the particles and their adhersion to the materials of the revetment or wall to be studied. The preparation of an emulsion of bitumen labelled with iodine-131 and its application in determining permeability gradients and detecting leaks in canal revetments are described. This method has a large range of applications. It can, for example, be successfully used to study the relative permeabilities of strata in which wells, pits or boreholes have been drilled, and to distinguish between areas of varying permeabilities. (Knapp-USGS)
W71-04879

METHOD OF DETERMINING LEAKAGE VELOCITIES THROUGH THE BOTTOM OF RESERVOIRS,
Institute of Nuclear Physics, Cracow, Poland.
A. Zuber.
Supported by International Atomic Energy Agency. In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM 129/48, p761-771, 1970. 11 p, 7 fig, 11 ref.

Descriptors: *Reservoir leakage, *Tracers, Tracking techniques, Flow, Pipe flow, Porous media, Groundwater movement, Instrumentation, Velocity, Seepage, Percolation.
Identifiers: *Reservoir leakage gage.

If a chosen area leaking in a reservoir bottom is tightly covered by a cylindrical cover with an outlet through a pipe, then the product of leakage velocity and the area covered is equal to the product of flow velocity in the pipe and the pipe cross-section. Even extremely low leakage velocities render measurable velocities in the pipe if its cross-section is very small in comparison with the covered area. This idea can be used for leakage velocity measurements if the measuring device does not disturb natural flow lines. Conditions under which this requirement is satisfied are considered in detail. A measuring device constructed according to these conditions and described in the paper can measure leakage velocities from 0.0000005 to 0.003 cm/sec. The flow velocity in the measuring pipe is known from the transit time measurement of an injected pulse of a radioisotope. (Knapp-USGS)
W71-04880

FLOOD ROUTING THROUGH STORM DRAINS: PART I. SOLUTION OF PROBLEMS OF UNSTEADY FREE SURFACE FLOW IN STORM DRAINS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, and A. H. Barnes.
Supported by Bureau of Public Roads and Public Health Service.Colorado State University Hydrology Paper No 43, November 1970. 107 p, 44 fig, 36 tab, 23 ref, 5 append.

Descriptors: *Routing, *Flood routing, *Storm drains, *Unsteady flow, Mathematical models, Computer programs, Hydraulic models, Waves (Water), Critical flow, Supercritical flow, Discharge (Water), Flow, Runoff, Storm runoff.
Identifiers: Storm drain flow routing.

Flood routing through storm drains was studied in a 3-ft diameter, 822-ft long storm conduit and theoretically in terms of the unsteady free-surface flow. Numerical integrations of differential equations by the specified interval scheme, the diffusing scheme, and the Lax-Wendroff scheme are discussed. The method of characteristics is selected for the practical integration procedure whenever the complete differential equations are used. Experimental and analytical investigations of the geometric and hydraulic parameters that define the coefficients of the two differential equations are summarized. The initial and boundary conditions are expressed mathematically for the numerical solutions. The analytically computed waves are then compared with the experimentally observed waves by using the same initial and boundary conditions. Qualitative and quantitative comparisons are given for depth hydrographs at different positions, for depth wave profiles at different instants in time, and for the peak-depth versus both position and time. From a practical point of view, good agreement is indicated by these comparisons. The errors in conduit geometric parameters, in hydraulic parameters, in numerical computations, and in experimental observations are analyzed and discussed. A bibliography of 145 entries is included in Appendix 2. (See also W71-04891 and W71-94892) (Knapp-USGS)
W71-04890

FLOOD ROUTING THROUGH STORM DRAINS: PART II. PHYSICAL FACILITIES AND EXPERIMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, and A. H. Barnes.

Colorado State University Hydrology Paper No 44, November 1970. 43 p, 49 fig, 13 tab, 13 ref.

Descriptors: *Flood routing, *Storm drains, *Hydraulic models, *Colorado, Routing, Unsteady flow, Laboratory tests, Waves (Water), Instrumentation, Calibrations, Computer programs.
Identifiers: Storm drain flow routing.

Experimental storm drain routing research facilities and experiments are described. Design and construction of the experimental storm drain system, instrumentation and calibration, the data recording system, various experimental test conditions and their typical results, and experimental errors are discussed. A large conduit, 3 feet in diameter and 822 feet long, was constructed in the Outdoor Laboratory of Colorado State University to accurately measure geometric and hydraulic characteristics, and the propagating of flood waves. The calibration of the instruments has been carried out to the point where there are relatively small errors. The data recording system was designed and constructed so that the output could be put either on cards or paper tapes and provide a direct input for computations on a digital computer. (See also W71-04890) (Knapp-USGS)
W71-04891

FLOOD ROUTING THROUGH STORM DRAINS: PART III. EVALUATION OF GEOMETRIC AND HYDRAULIC PARAMETERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, and A. H. Barnes.
Colorado State University Hydrology Paper No 45, November 1970. 37 p, 24 fig, 12 tab, 10 ref.

Descriptors: *Flood routing, *Storm drains, *Hydraulic models, Hydraulics, Unsteady flow, Non-uniform flow, Channel morphology, Flow resistance, Hydraulic design, Shear drag, Roughness (Hydraulic).
Identifiers: Storm drain flow routing.

Results are given of investigation of the geometric and hydraulic parameters of an experimental storm drain routing facility. The errors in cross section geometric parameters are analyzed in a conduit not ideally circular but approximated by an elliptical shape; errors are also analyzed when the undulations in the longitudinal slope of the conduit affect the predicted water surface profiles and thus the geometric parameters for a given water depth. The variation of hydraulic parameter of resistance, expressed by the Darcy-Weisbach friction factor, is experimentally determined and compared to the theoretical relation to Reynolds number. Energy losses in a 90 deg junction box are studied. The velocity distribution coefficients are shown to vary with the Darcy-Weisbach friction factor, and consequently, with the depth of flow. Boundary conditions for both controlled and free outfall are experimentally determined and approximated by power functions. Two types of steady non-uniform flow profiles were observed and analyzed as the initial conditions for the unsteady flow computations. (See also W71-04890) (Knapp-USGS)
W71-04892

FLOOD HAZARD INFORMATION, ROSE CANYON AND SAN CLEMENTE CANYON, CITY OF SAN DIEGO, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.

Corps of Engineers Flood Plain Report, July 1970. 14 p, 3 fig, 15 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, *California, Regional flood, Flood forecasting, Flood control, Statistical methods.
Identifiers: *San Diego (Calif), Standard project flood, Intermediate regional flood.

Flooding along Rose Canyon from its confluence with San Clementa Canyon to a point about 6 mi upstream in San Diego, California, is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating to the extent of flooding which might occur, based on available records of rainfall, runoff, historical flood heights, and other technical data. No records of past floods are available, but large floods could occur in Rose Canyon. Peak discharge of the Intermediate Regional Flood is estimated at 6,200 cfs 3.4 mi above the mouth of Rose Canyon. The Standard Project Flood peak discharge is estimated at 8,900 cfs. (Woodard-USGS)
W71-04904

FLOOD PLAIN INFORMATION, HATCHIE RIVER, PLEASANT RUN CREEK AND SPRING CREEK, BOLIVAR, TENNESSEE.
Corps of Engineers, Memphis, Tenn.

Prepared for the city of Bolivar. Corps of Engineers Flood Plain Report, August 1970. 39 p, 8 fig, 19 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, *Tennessee, Historic flood, Flood forecasting, Regional flood, Overflow, Design flood, River basin development, Land use.
Identifiers: *Hatchie River, Bolivar (Tenn), Intermediate regional flood, Standard project flood.

A summary of the flood situation at Bolivar, Tenn. is described to aid in solving local flood problems and for planning the best utilization of flood-prone lands. Situated on the left bank of Hatchie River between Pleasant Run and Spring Creek, Bolivar's principal residential and commercial developments are on ground outside the flood plains of the river and Spring Creek, but large portions of land potentially developable have been inundated and this study shows that even greater portions are subject to flooding in the future. Maps, profiles, cross sections, and descriptive material relating past flooding to potential flooding are based on available records of rainfall, runoff, historical flood heights, and other technical data. Records from U.S. Geological Survey stream gaging stations on Hatchie River at State Highway 18, beginning in 1929, and on Pleasant Run at the old U. S. 64 bridge, from 1954, are the basis for much of this report. The greatest flood known on the Hatchie occurred in February 1948; other great floods occurred in Janurary 1946 (second in size), and in January 1935. Winter and spring are the main flood seasons. The Hatchie River flood of 1948 rose to its crest stage in 14 days and was out of banks for 78 days. (Lang-USGS)
W71-04905

PROGRESS REPORT ON AQUATIC WEED CONTROL STUDIES,
Bureau of Reclamation, Denver, Colo. Office of Chief Engineer.
Otto E. Naman.
Available from NTIS as PB-195 774, $3.00 in paper copy, $0.95 in microfiche. Bureau of Reclamation Report REC-OCE-70-26, July 1970. 35 p, 5 fig, 8 tab, 9 ref.

Descriptors: *Aquatic weeds, Dispersing agents, *Herbicides, Aromatic solvents, Water analysis, Irrigation systems, *Weed control, Irrigation canals, Soil treatment, Limnology, Aquatic life, Ecology, *Aquatic weed control, Pondweeds, Phytotoxicity.
Identifiers: Carter Lake, Colo, Xylene, Product evaluation, Progress reports, Aquatic weed study facility.

Laboratory and preliminary field studies on submersed aquatic weed control methods are reported. Several experimental compounds and combinations of herbicides were evaluated for herbicidal activity in greenhouse tests. Only one material was active when applied to the aquatic soil. One new experimental herbicide, formulated allylidene diacetate, showed promise for controlling aquatic weeds in irrigation canals when applied to the total water volume. This material was also active when combined with nonphytotoxic levels of xylene. The ammonia ion was active on aquatic weeds in static water, but less effective in flowing water. Seven experimental herbicide treatments were evaluated for activity on pondweeds at the Carter Lake Aquatic Weed Test Station. Allylidene diacetate was the most promising and was suggested for field testing in an operating irrigation canal. Data are presented on studies for determining the effects of mineral nutrients on the productivity of 2 pondweeds. Preliminary results suggest that mineral enrichment of water has little direct influence on pondweed productivity.
W71-04957

SYNTHESIZING HYDROGRAPHS FOR SMALL SEMIARID DRAINAGE BASINS,
Geological Survey, Cheyenne, Wyo.
For primary bibliographic entry see Field 02A.
W71-04972

CONSERVATION, CONTROL, AND USE OF WATER RESOURCES OF THE MISSOURI RIVER BASIN.
Department of the Interior, Washington, D.C.
For primary bibliographic entry see Field 06E.
W71-04986

SURFACE WATER CONTROL IN NEW JERSEY, DRAINAGE, FLOOD CONTROL AND RELATED POLICIES IN AN URBAN STATE,
Rutgers-The State Univ., New Brunswick, N.J. Bureau of Government Research.
Stephen A. Decter.
August 1967, Part I. 125 p, 137 ref.

Descriptors: *New Jersey, *Legislation, *Surface waters, *Water control, State governments, Surface runoff, Repulsion (Legal aspects), Riddance (Legal aspects), Judicial decisions, Legal aspects, Administrative agencies, Erosion, Storm runoff, Floowater, Flood control, Water law, Natural flow doctrine, Drainage, Drainage systems, Drainage water, Surface-groundwater relationships, Cities, Drainage programs, Urbanization, Water policy.

Part I of a two-part report submitted by the New Jersey Bureau of Government Research, this study of surface water control in New Jersey is divided into three chapters: (1) framework for a water policy; (2) laws of water control; and (3) administration of water resources. In chapter one, basic policy goals--including environmental, developmental, and governmental goals--problems in achieving these goals, and the difficulty in determining the public interest are discussed. Chapter two examines: (1) elements of water control; (2) inventory of water control functions; (3) the constitutional-common-law framework of water control; (4) authority to begin operations under statutory laws of water control, including disposal and control of surface water during ordinary weather, disposal of storm surface water, control of floodwaters, and acquisition of lands and waters; and (5) collection and development of data under statutory laws of water control. The criteria for appraising administrative adequacy, examination of government levels--including municipal, county and state levels--and inter-level coordination are discussed in chapter three. (See also W71-04787) (Hart-Florida)
W71-04995

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 2, SECTION B-HYDROLOGY,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W71-05037

SIMULATION THEORY APPLIED TO WATER RESOURCES MANAGEMENT,
Nevada Univ., Reno. Center for Water Resources Research.
For primary bibliographic entry see Field 06A.
W71-05042

FLOOD PLAIN INFORMATION OF RAPPAHANNOCK RIVER, FREDERICKSBURG, SPOTSYLVANIA AND STAFFORD COUNTIES, VIRGINIA.
Corps of Engineers, Norfolk, Va.

Corps of Engineers Flood Plain Report, September 1970. 53 p, 11 fig, 12 plate, 11 tab.

Descriptors: *Floods, *Flood plains, *Flood protection, *Virginia, Historic flood, Flood forecasting, Dams, Land use, Planning, Flood damage.
Identifiers: *Rappahannock River, Intermediate Regional Floods, Standard Project Flood.

This report describes flood situations along the Rappahannock River in two significant phases--historical floods and probable future floods. Its purpose is to help define local flood problems and how to best utilize land subject to overflow. The report is based on rainfall and runoff data, historical and current flood heights, and other technical data available for the river basin. Maps, profiles, cross sections, and photographs are used to show the extent of past flooding and of probable future floods. The Rappahannock rises in the Blue Ridge Mountains in northern Virginia and flows southeasterly to Fredericksburg where it becomes a tidal stream for the next 100 mi and discharges into Chesapeake Bay. This report gives details for the flood plain reach from Muddy Creek upstream to Embrey Dam above Fredericksburg. The greatest flood of record occurred in October 1942. The second greatest was in April 1937, and was only 1 ft below the 1942 flood at the USGS gaging station. Other large floods occurred in June 1889, May 1901, May 1924, October 1924, and August 1955 (the 3rd highest). During the record 1942 flood the river had a maximum rate of rise of 3 ft per hr and remained above the 18-ft flood stage for 48 hr at Fredericksburg. (Lang-USGS)
W71-05071

FLOOD PLAIN INFORMATION OF TOBESOFKEE CREEK, MACON AND BIBB COUNTY, GEORGIA.
Corps of Engineers, Savannah, Ga.

Corps of Engineers Flood Plain Report, June 1970. 48 p, 18 fig, 49 plate, 14 tab.

Descriptors: *Floods, *Flood plains, Flood damage, *Georgia, Regional flood, Historic flood, Flood forecasting, Design flood.
Identifiers: *Tobesofkee Creek (Bibb County, Ga.).

Flooding along Tobsofkee Creek near Macon, Georgia, is described to aid in solving local flood problems and in planning the best utilization of flood-prone lands. Maps, profiles, cross sections, and text material relating the extent of past flooding to floods which might occur in the future are based on available records of rainfall, runoff, historical flood heights and other technical data. Records from U. S. Geological Survey stream gaging stations were used to determine flooding, including that caused by backwater from Ocumulgee River. The greatest flood known on this creek occurred in September, 1929, and other large floods occurred in December 1941, March 1944, December 1964. The analysis indicates that intermediate regional floods (100 year avg occurrence) would be about 3 ft higher than the March 1944 flood. Duration of floods is short, stages can rise from stream bed to extremes peaks in less than 12 hr after intensive rainfall. Hazardous conditions occur during large floods as a result of rapid rise of water, high velocities, and deep flows. (Woodard-USGS)
W71-05072

ANALYSIS OF RESERVOIR YIELD,
Missouri Univ., Columbia. Dept. of Civil Engineering.
Allen T. Hjelmfelt, Jr.
Water and Sewage Works, 1970 Reference Number, Vol 117, p R14-R15, November 28, 1970. 2 p, 3 fig, 5 ref.

Descriptors: *Reservoir yield, *Mathematical models, *Equations, *Hydrology, *Statistical methods, Analytical techniques, Water supply, Planning, Water resources, Probability, Forecasting, Reservoirs.
Identifiers: Projections.

A probabilistic method for determining the expected yield of reservoirs is described. The aim of the analysis is to establish the probability of not being able to meet the demand. The results of the computations are shown. The probability of the reservoir ending a cycle at a given level or less is graphed against time. The lines are drawn only to indicate trends; they do not indicate a continual process during the year. As time progresses the lines approach the horizontal. That indicates that the distribution is stationary. The analytical method described is easy to use and results in a more meaningful solution than do the more simple mass diagram approaches. For practical application the reservoir would have to be divided into many more levels, resulting in a larger system of equations to be solved. (Woodard-USGS)
W71-05081

LAKES--RESTORATION AND PRESERVATION,
Federal Water Quality Administration, Cincinnati, Ohio. Field Investigations Branch.
For primary bibliographic entry see Field 05C.
W71-05082

POTENTIAL ALGICIDES FOR THE CONTROL OF ALGAE,
Los Angeles County Sanitation District, Calif.
For primary bibliographic entry see Field 05G.
W71-05083

EXPERIMENTAL FLUME INVESTIGATION OF HYDRAULIC TRANSIENTS IN RIVER-RESERVOIR SYSTEMS,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 02E.
W71-05087

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART II. PACIFIC SLOPE BASINS IN CALIFORNIA - VOLUME I.
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W71-05090

SOME RECENT RESEARCH ON LAND DRAINAGE,
Iowa State Univ., Ames. Water Resources Research Inst., and Alexandria Univ. (Egypt). Dept. of Soil Sciences.
Don Kirkham, and H. Baker.
Agrokemia es Talajtan (Agrochemistry and Soil Science), Vol 18, Supplementum, p 295-306, 1969. 12 p, 13 fig, 23 ref. OWRR Project A-003-IA (10) and B-002-IA (5).

Descriptors: *Drainage, *Leaching, *Saline soils, Land reclamation, Salinity, Diffusion, Groundwater movement, Soil water movement, Irrigation water, Infiltration, Percolation.
Identifiers: *Land drainage effects.

Some recent theoretical and laboratory research at Iowa State University, Ames, Iowa, USA is reviewed under the headings: (1) removal of sodium salts from soil by different methods of application of water; (2) drainage of stratified soils; (3) drainage of land underlain by an artesian aquifer; (4) improvements in the theory of the piezometer method for assessing soil drainability; and (5) depth of moisture penetration in soil due to irrigation water advancing over the soil surface. (Knapp-USGS)
W71-05102

EFFECT OF HANFORD PLANT OPERATIONS ON THE TEMPERATURE OF THE COLUMBIA RIVER, 1964 TO PRESENT,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05C.
W71-05116

STATISTICAL RELATIONSHIPS BETWEEN STORM AND URBAN WATERSHED CHARACTERISTICS,
Utah State Univ., Logan. Water Research Lab.
V. V. Dhruva Narayana, M. Akbar Sial, J. Paul Riley, and Eugene K. Israelsen.
Available from NTIS as PB-197 853, $3.00 in paper copy, $0.95 in microfiche. Completion Report PRWG 74-2, August 1970. 55 p, 11 fig, 15 tab, 47 ref, 2 append. OWRR Project B-025-UTAH (4).

Descriptors: Urbanization, Statistical hydrology, Watershed studies, Hydrology, Surface runoff, Urban parameters, Runoff characteristics, Illinois, *Forecasting, *Drainage.
Identifiers: *Statistical hydrology, *Flood frequency, Parameters runoff, Storm vs runoff characteristics, Small watershed runoff estimates, Urbana (Ill), Urban hydrology, *Urban drainage, Boneyard Creek (Ill).

Because of the rapid urban development in recent years, hydrologic problems associated with urban watersheds have gained importance. Large sums of money are being spent for the design of urban drainage systems based upon inadequate procedures for predicting peak runoff rates. A procedure is proposed for predicting peak runoff rates from small urban and rural watersheds based upon measurable storm and watershed characteristics. The technique was tested for a number of runoff events on the Boneyard Creek watershed at Urbana, Illinois, and the results of this test are included. The procedure will be particularly useful for estimating runoff rates from small ungaged drainage areas, and thus will be directly applicable to both design and water management problems.
W71-05144

PROBLEMS IN DEVELOPING A NATIONAL FLOOD-PROTECTION POLICY,
American Water Works Association, New York.
Gordon F. White.
In: Water, Health, and Society, Bloomington, Indiana University Press, 1969, p 148-159.

Descriptors: *Flood control, *Water resources development, *Water uses, Engineering, Hydrology, Social aspects, Economic evaluation, Hydrology, Forests, Soil conservation, Dams, Cost-benefit analysis, Water supply, Reservoirs, Irrigation, Navigation.
Identifiers: *Muskingum River, *Multiple use development.

The shortcomings in national flood protection measures are discussed in order to clarify the problems involved in developing a national flood protection policy. Considerable damage is caused by incomplete engineering studies of past destructive floods. The author calls for an accurate assessment of local and national needs in order to provide a more accurate cost-benefit analysis. There is a need for detailed programs of flood protection that meet the social and economic needs of all water uses. The author cites the interrelationship between a National Flood Protection Policy and a general National Water Resources Policy. The elements of such a policy are proposed to run the gamut of engineering, finance, administration, politics, and economics. The ultimate goal of such

national policy would be a basic Water Resources policy, changing in character, logical in administration and geared to the needs of the consumer. Government and private agencies callaberation on various studies to bring this about are surveyed in light of their proposed contribution to eventual successful policy-making. (Murphy-Rutgers)
W71-05228

STABILITY OF CLOSED HORIZONTAL DRAINAGE IN THE GOLODNAYA STEPPE,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 08D.
W71-05254

4B. Groundwater Management

POROSITY AND DISPERSION CONSTANT CALCULATIONS FOR A FRACTURED CARBONATE AQUIFER USING THE TWO WELL TRACER METHOD,
Geological Survey, Denver, Colo. Water Resources Div.
For primary bibliographic entry see Field 02F.
W71-04859

PERTURBATION SOLUTIONS OF THE DISPERSION EQUATION IN POROUS MEDIUMS,
Technion-Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 02F.
W71-04860

INFLUENCE CHART FOR REGIONAL PUMPING EFFECTS,
Hydrologic Commission of the Valle de Mexico Basin, Mexico City.
German E. Figueroa Vega.
Water Resources Research, Vol 7, No 1, p 209-210, February 1971. 2 p, 1 fig, 4 ref.

Descriptors: *Drawdown, *Hydrogeology, Water wells, Aquifers, Transmissivity, Storage coefficient, Mathematical studies, Groundwater movement, Water table, Flow nets.
Identifiers: Mexico.

If water is withdrawn from a confined aquifer by wells that are areally distributed over arbitrary portions of the aquifer, the resulting drawdowns are variable with time and space. An influence chart is presented that, within its own limitations, makes possible the calculation of the regional effects of pumping without the help of analog or digital models. (Knapp-USGS)
W71-04867

MATHEMATICAL MANAGEMENT MODEL–UNCONFINED AQUIFER,
Texas Tech Univ., Lubbock. Water Resources Center; and High Plains Underground Water Conservation District No. 1, Lubbock, Tex.
For primary bibliographic entry see Field 02F.
W71-04931

STATUS OF SALT-WATER ENCROACHMENT IN 1969 IN SOUTHERN NASSAU AND SOUTHEASTERN QUEENS COUNTIES, LONG ISLAND, NEW YORK,
Geological Survey, Mineola, N.Y.
For primary bibliographic entry see Field 02L.
W71-04976

STEADY STATE FLOW AROUND A WELL IN A TWO-LAYERED AQUIFER,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 02F.
W71-05044

SPACING OF DRAINAGE WELLS IN A LAYERED AQUIFER,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 02F.
W71-05045

FIFTEENTH ANNUAL WATER CONFERENCE.
New Mexico State Univ., University Park. Water Resources Research Inst.

Proceedings Fifteenth Annual Water Conference, March 12-13, 1970, New Mexico State University Water Resources Research Institute, Las Cruces, 1970. 113 p. OWRR Project A-999-N Mex (5).

Descriptors: *Water resources development, *Water supply, *Water utilization, *New Mexico, *Water management (Applied), Water requirements, Groundwater, Surface waters, Water conservation, Water pollution, Irrigation, Domestic water, Municipal water, Stock water, Planning, Interstate, Ecology, Soil properties, Social needs, Benefits, Costs, Water demand, Water balance.
Identifiers: *Water Conference (New Mexico).

Seventeen papers concerning water resources development were presented at the 1970 Annual Water Conference sponsored by the New Mexico Water Resources Institute. Emphasis was on planning, management, research, utilization, costs, quality, benefits, standards, and classification of water needs in New Mexico. (See also W71-05066 thru W71-05068) (Woodard-USGS)
W71-05065

IRRIGATION WATER REQUIREMENTS FOR CROP PRODUCTION IN THE ROSWELL ARTESIAN BASIN,
New Mexico State Univ., University Park. Dept. of Agricultural Economics and Agricultural Business.
Robert R. Lansford.
In: Proceedings Fifteenth Annual Water Conference, March 12-13, 1970, New Mexico State University Water Resources Research Institute, Las Cruces, p 79-91, 1970. 13 p, 4 fig, 2 tab. OWRR Project A-999-N Mex (5).

Descriptors: *Irrigation water, *Water requirements, *Groundwater, *Crop production, *New Mexico. Artesian wells, Water rights, Irrigated land, Legal aspects, Water law, Economic import, Crop response, Model studies, Mathematical models, Linear programming, Cost-benefit analysis, Economics.
Identifiers: *Roswell Artesian Basin (New Mexico).

In 1966 judgment and decree defined water rights in the Roswell Artesian Basin, New Mexico. The duty of water for irrigated agriculture was established at three acre-feet per acre per annum, only to be exceeded in any one year provided that the total amount diverted during any period of five consecutive years shall not exceed five times the annual duty of water. A study was initiated to assemble and analyze existing cropping patterns, water use, water quality, soil quality, crop yields, and income effects from the judgment and decree. This paper is concerned with the economic or income aspects. The data for the analysis was derived from information obtained on 12 case study farms for the calendar years 1966, 1967 and 1968. Linear programming was chosen as an analytical tool for the economic analysis. The primary purpose was to determine the effect of different quantities of irrigation water on net farm returns. A typical farm budget was developed to compare with results of linear programming to determine the economic effect of restricting the diversion of irrigation water at seven different levels. The average net farm return was $91.35 per water-right acre. (See also W71-05065) (Woodard-USGS)
W71-05066

OBJECTIVES OF A CURRENT STUDY OF SALINE GROUNDWATER IN THE TULAROSA BASIN, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
J. S. McLean.
In: Proceedings Fifteenth Annual Water Conference, March 12-13, 1970, New Mexico State University Water Resources Research Institute, Las Cruces, p 95-100, 1970. 6 p, 3 fig. OWRR Project A-999 N Mex (5).

Descriptors: *Groundwater, *Saline water, *Water quality, *Saline water systems, *New Mexico, Water resources, Fresh water, Water utilization, Consumptive use, Aquifers, Water wells, Water yield, Irrigation water, Domestic water, Stock water, Municipal water.
Identifiers: *Tularosa Basin (New Mexico).

This study of the saline-water resources of the Tularosa Basin, New Mexico, delineates the extent and volume of saline-water zones of specified ranges in concentration; determines the yields of present wells; and estimates the potential yields of future wells completed in the saline-water zones. Fresh water was defined as water containing less than 1 gram per liter of dissolved solids. Two freshwater lenses occur in the alluvial fill adjacent to the mountains of the east and west sides of the southern part of the basin. The water in the alluvial fill increases in salinity with depth below these fresh-water lenses. Salinity also increases toward the center of the basin where water three times as saline as sea water has been found. Groundwater containing 1 to 3 grams per liter of dissolved solids is used for municipal, domestic, stock, and irrigation supply. Only a few stock wells use water containing 3 to 10 grams per liter of dissolved solids. Groundwater containing more than 35 grams of dissolved solids per liter (about the salinity of sea water) may be present in over 90% of the alluvial fill in the basin. Wells in the basin yield from a few gallons per minute to 1,400 gallons per minute. (See also W71-05065) (Woodard-USGS)
W71-05067

IRRIGABILITY CLASSIFICATION OF NEW MEXICO LANDS,
New Mexico Agricultural Experiment Station, University Park.
J. U. Anderson.
In: Proceedings Fifteenth Annual Water Conference, March 12-13, 1970, New Mexico State University Water Resources Research Institute, Las Cruces, p 104-106, 1970. 3 p, 1 tab, 1 ref. OWRR Project A-999 N Mex (5).

Descriptors: *Irrigable land, *Land classification, *Irrigation, *New Mexico, Land development, Soils, Soil properties, Soil moisture, Retention, Salinity, Soil density, Permeability, Porosity, Soil structure, Drainage, Soil types, Soil water movement, Topography, Soil-water-plant relationships.
Identifiers: *Irrigability classification.

A proposed new classification system establishes four classes of irrigable land and one class of non-irrigable land in New Mexico. Class 1 land has few or no limitations for irrigation; class 4 land has very severe limitations; class 6 land is non-irrigable. The criteria used to determine irrigation land class are tabulated. The suitability of New Mexico lands for irrigation is highly variable. In the counties which have been studied in eastern New Mexico, the amount of class 1 land varies from 61.5% in Curry County to 1% in Lea County, and the total irrigable land varies from 94% in Curry to 34% in Eddy County. In southwestern New Mexico Luna County has 13% class 1 and 64% total irrigable land. In Hidalgo the comparable figures are 10 and 46%. The factors that most frequently limit the suitability of New Mexico soils for irrigation are insufficient available water holding capacity, and insufficient effective soil depth. However, the results do show extensive areas which are in classes 1 and 2, and are thus very well suited to irrigation. (See also W71-05065) (Woodard-USGS)
W71-05068

HYDROLOGIC IMPLICATIONS OF SOLID-WASTE DISPOSAL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 05B.
W71-05094

SOFT WATER SUPPLY FOR URBAN CONSUMPTION, A FEASIBILITY STUDY,
Water Planning for Israel Ltd., Tel-Aviv.
P. Dalinky.
In: The Proceedings of the Jerusalem International Conference on Water Quality and Pollution Research, p 79-87, June 1969.

Descriptors: *Groundwater, Economic feasibility, Forecasting, Cost-benefit analysis, Aquifer.
Identifiers: *Soft-water supply, Hard-water, Public expenditures.

Municipal water supply in Israel is based mainly on groundwater sources that have a high degree of hardness because of the chemical composition of the aquifers. The author first considers the influence of water hardness on the consumption of soaps and detergents and finds direct relationships exist. Furthermore, water hardness is related to greater wear of clothing. An economic analysis of the savings or benefits due to the use of a soft water supply is made. The largest savings are found in the reduction of salt expenditures for ion-exchange softening plants that are used in hospitals and industry. Savings are also found in the reduction of clothes wear-and-tear and in soap consumption. The analysis does not consider the costs associated with the use of soft water; namely, the problems arising from internal corrosion of unlined pipes which is necessary for a cost-benefit analysis of the feasibility of soft water supply. This article is relevant to studies of this same problem in the United States. (Siegenthaler-Rutgers)
W71-05215

WATER RESOURCE MANAGEMENT IN ARID ENVIRONS,
Resources for the Future, Washington, D.C.; and Iowa State Univ., Ames.
R. G. Cummings, and D. L. Winkelman.
Water Resources Research, Vol 6, No 6, p 1559-1568, December 1970.

Descriptors: *Water resource management, Aquifers, Resource allocation, Discount rate, Interest rate, Depreciation, Economic efficiency.
Identifiers: *User cost, Lagrangian multiplier, Sensitivity analysis.

An analytical model is presented which results in optimum decision rules for the conjunctive management of a reservoir and an aquifer in arid regions. First, the decision environment for water resource management in arid environs is developed. The model focuses on several interrelated questions associated with maximizing a benefit function based on agriculture production with given stocks of water and expected water receipts, namely, the optimum pattern of land use and production, the optimum intertemporal allocation of water and the optimum rate of investment in capital for water distribution. Extraction of water from the reservoir and aquifer is found at the point where the value of current groundwater in present value terms is equal to the marginal expected value of the groundwater stock. The marginal storage value of the reservoir stock is discounted by a capital survival factor to arrive at benefits net of depreciation effects. The optimum rate of investment at each land group is found where the expected marginal costs of investment equal the marginal expected value of investment discounted by interest rates and depreciation. (Siegenthaler-Rutgers)
W71-05216

PHOTOGRAPHIC EVALUATION OF WATER WELLS,
Layne Texas Co., Inc., Houston.
For primary bibliographic entry see Field 07B.
W71-05299

APPLICATION OF ROTARY DRILLING TO WATER WELLS,
J. P. Miller Artesian Well Co., Brookfield, Ill.
For primary bibliographic entry see Field 08A.
W71-05307

USE OF GEOPHYSICAL LOGS IN SOIL ENGINEERING,
Mandrel Industries, Houston, Tex. Well Instrument Div.
For primary bibliographic entry see Field 08D.
W71-05310

WATER WELL INCREASING COSTS OF INSTALLATION AND MAINTENANCE,
Layne Texas Co., Houston, Tex.
For primary bibliographic entry see Field 08G.
W71-05319

4C. Effects on Water of Man's Non-Water Activities

STORM RUNOFF RESPONSE FROM ROAD-BUILDING AND LOGGING ON SMALL WATERSHEDS IN THE OREGON COAST RANGE,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
Frederic Shu-kong Hsieh.
M.Sc. Thesis, Oregon State University, June 1970. 149 p, 38 fig, 16 tab, 79 ref, 4 append. OWRR Project A-001-OREG (6).

Descriptors: *Storm runoff, *Small watersheds, *Lumbering, *Oregon, Overland flow, Road construction, Forest fires, Streamflow, Flow rates, Peak discharge, Vegetation effects, Hydrology, Rainfall, Topography, Climates, Soils, Geology, Mathematical studies, Equations, Clear-cutting.
Identifiers: *Runoff response variables, *Logging (Timber).

The effects of roadbuilding, logging, and forest burning upon stream runoff responses to storms are evaluated for the Alsea experimental watersheds, located in the Oregon Coast Range. The parameters analyzed are peak discharge, time-to-peak, and storm-runoff volume. The volume parameter is further subdivided into toal, quick, delayed, rising limb, and falling limb flows. The control-watershed approach and linear regression method are utilized. Calibration of the main stations at Flynn Creek (502 acres) and Deer Creek (750 acres) started in 1958. That for subwatershed DC II (138 acres) and DC III (100 acres) started in 1962. The storm-runoff responses were related to the type of treatment applied and percent of area treated. Roadbuilding resulted in significant increases in peak and induced peak discharges on DC III, which was subjected to the most intensive treatment. Logging generally caused greater runoff than did roadbuilding, because more vegetation was removed. Rising limb flow on DC III as well as at the Deer Creek main station was moderately increased after logging. Effects on design floods after treatments were indicated by the sharp increases in peak discharges, based upon flood frequency and statistical analyses. (Woodard-USGS)
W71-04968

WISE USE OF FLOOD PLAINS.
New England River Basins Commission, Boston, Mass.
For primary bibliographic entry see Field 06F.
W71-04994

STATISTICAL RELATIONSHIPS BETWEEN STORM AND URBAN WATERSHED CHARACTERISTICS,
Utah State Univ., Logan. Water Research Lab.
For primary bibliographic entry see Field 04A.
W71-05144

4D. Watershed Protection

CONTROL OF WATER POLLUTION DURING DAM CONSTRUCTION,
California State Dept. of Water Resources, Sacramento; and Santa Ana Regional Water Quality Control Board, Riverside, Calif.
For primary bibliographic entry see Field 05G.
W71-04888

THE ESTABLISHMENT OF VEGETATION ON NONTOPSOILED HIGHWAY SLOPES IN WASHINGTON,
Washington State Univ., Pullman. Agricultural Research Center.
Roy L. Goss, Robert M. Blanchard, and William R. Melton.
Available from NTIS as PB-196 158, $3.00 in paper copy, $0.95 in microfiche. Final Report Research Project Y-1009, Nov 1970. 29 p, 8 fig, 6 tab, 24 ref. DOT supported.
Identifiers: *Highways, *Vegetation, *Erosion control, Washington State, *Landscaping, Highways, Slopes, Loams, Grasses, Mulches, Straw, Asphalts, Emulsions, Subsoil, Fertilizers.

Various factors of erosion control and vegetation establishment were studied over a four year period in Washington. Included were: (1) establishment of grass/legume cover without the use of topsoil, (2) species of grasses and clover and proportion of each, (3) mulching materials and (4) fertilization. Erosion control vegetation can be established on subsoils without topsoil. There were no differences found among genera and species of seed tested. Subsoils, as exposed from construction, supported good stands of grass provided adequate fertilizers were supplied and they were given proper protection (mulching) from erosion. On erodible sites on 2:1 slopes or steeper, excelsior matting or straw tacked with asphalt emulsion was superior to all other materials tested. Refertilization is important.
W71-05147

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON, OHIO,
Agricultural Research Service, Beltsville, Md. Soils Lab.
For primary bibliographic entry see Field 05B.
W71-04856

STABLE CARBON ISOTOPES IN BLUE-GREEN ALGAL MATS,
Texas Univ., Port Aransas. Inst. of Marine Science; and Texas Univ., Port Aransas. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02L.
W71-04873

DISTRIBUTION OF BACTERIA IN FECES OF SWINE,
Missouri Univ., Columbia.
Gloria D. Rall, Arletta J. Wood, R. B. Wescott, and A. R. Dommert.
Applied Microbiology, Vol 20, No 5, p 789-792, Nov 1970. 3 tab, 2 fig, 12 ref. Public Health Service grants RR-00390 and RR-00285.

Descriptors: *Bacteria, *Distribution, Farm wastes, Patterns, Microorganisms, Pollutant identification.
Identifiers: *Fecal samples, *Swine, Frequency, Distribution.

A new technique is described for evaluating bacterial cell distribution in fecal samples. Spatial rela-

tionships of cells within an area rather than number of cells per unit volume or weight are measured by this technique. Measurements of cell distribution by this method indicated that bacteria occurred in freshly voided swine feces as pure, discrete colonies rather than as single cells distributed randomly or uniformly throught the sample. (Christenbury-Iowa State)
W71-04923

ODOR TRANSPORT BY PARTICULATE MATTER IN HIGH DENSITY POULTRY HOUSES,
Cornell Univ., Ithaca, N.Y. Dept. of Food Science.
William E. Burnett.
Poultry Science, Vol 48, No 1, p 182-185, 1969. 1 fig, 1 tab, 9 ref.

Descriptors: *Farm wastes, *Poultry, *Odor, Gas chromatography, Volumetric analysis, Volume, Filters, Nitrogen, Organoleptic properties, Ventilation, Pollutant identification, Air pollution, Pollution abatement.
Identifiers: *Particulate matter, Odor transport, Odor panel, Volatiles, Concentrations, Odoriferous components.

The report investigates the concentrations of airborne particulate matter in a high density poultry house and the role of particulate matter as an odor transport mechanism. Particulate matter collected by high volume samplings, of a commercial poultry house atmosphere revealed that the particulates had a 'chicken house' odor. Gas chromatographic analyses of the volatiles carried by the particulates revealed the presence of a number of individually odoriferous compounds. Large quantities of particulate matter are probably expelled from poultry houses by ventilation fans. Whether particulate matter plays a significant role in ambient odors from poultry houses should be investigated since the particulates represent a retentive source of odors. (White-Iowa State)
W71-04924

AUTOMATED METHOD FOR DETERMINING AND REMOVING SILICA INTERFERENCE IN DETERMINATION OF SOLUBLE PHOSPHORUS IN LAKE AND STREAM WATERS,
Guelph Univ. (Ontario). Dept. of Soil Science.
F. Ross Campbell, and R. Leslie Thomas.
Environmental Science and Technology, Vol 4, No 7, p 602-604, 1970. 2 fig, 1 tab, 9 ref.

Descriptors: *Analysis, *Analytical techniques, *Color reactions, Data collections, Ammonium compounds, Phosphorus, Silica, Automation.
Identifiers: *Ammonium molybdate, Auto-analyzer techniques.

The ability of ammonium molybdate to attain blue color in the presence of not only phosphorus, but also silica, yields erroneous results in analyses of lake and stream waters. The deviations are of particular importance when the concentration of phosphorus is in the low microgram/liter range. The method described in this report permits an automated simultaneous determination of soluble phosphorus and the silica interference. (Wilde-Wisconsin)
W71-04962

DETERMINATION OF PROTEIN IN WASTE WATER,
Texas Western Coll., El Paso. Dept. of Civil Engineering.
Calvin Woods.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965, Purdue University, Vol XLIX, No 4, July 1965, p 501-515. 7 fig, 4 tab, 16 ref.

Descriptors: *Protein, *Nitrogen, *Colorimetry, Color, Calibrations, Peptides, Carbohydrates, Ammonia, Temperature, Waste water treatment, *Pollutant identification, *Analytical techniques.
Identifiers: *Kjeldahl method, Folin reaction, Biuret reaction, Sensitivity, Optical density, Interference, Tyrosone, Tryptophan.

The Kjeldahl organic nitrogen method, the Folin colorimetric method, and the Biuret reaction were analyzed as to their ability to determine the amounts of protein present in a solution. The Kjeldahl method measures organic nitrogen in the solution. Since protein is approximately 16% nitrogen, the nitrogen concentration is assumed to be entirely present in the protein structure and is multiplied by 100/16 or 6.25 to give the protein concentration. This method requires specialized equipment, is expensive, and time consuming. The Biuret reaction involves addition of a weak concentration of copper sulfate to an alkaline solution of proteins to yield a characteristic purple color, indicating the presence of a peptide bond. However, ammonia must be removed prior to the test since it interferes with the reaction. The amount of color developed depends upon the number of peptide bonds present so each protein has a different color. This reaction is the least sensitive of the methods discussed. The Folin reaction is the result of two reactions: the reaction of copper with protein in an alkaline solution and the reduction of the phosphomolybdic-phospho-tungstic reagent by the copper treated protein. This reaction has no known interferences, it is 100 times more sensitive than the Biuret reaction, it is easy to perform, and it is the only one specifically adapted to determining the soluble protein content of waste waters after centrifugation. (Lowry-Texas)
W71-05029

ENERGY, TOTAL CARBON, AND OXYGEN DEMAND,
Rice Univ., Houston, Tex. Dept. of Chemical Engineering.
A. W. Busch.
Proceedings Industrial Waste Conference, 20th, May 4, 5, 6, 1965, Purdue University, Vol XLIX, No 4, p 457-469, July 1965. 6 fig, 2 tab, 25 ref.

Descriptors: *Organic matter, *Oxygen demand, *Energy, Carbon, Thermodynamics, Biological treatment, Biochemical oxygen demand, Biodegradation, Chemical oxygen demand, Waste water treatment, Oxidation, Organic wastes, *Pollutant identification.
Identifiers: *Total carbon, Substrate, Total carbon analyzer, Organic pollution.

Certain concepts held basic to the measurement of organic pollution are emphasized and data relating to the use of parameters other than oxygen consumption for organic pollution definition and measurement are presented. Only soluble organics are of basic significance in biological oxidation. Work at Rice University has resulted in the definitions of two methods for the measurement of biodegradable soluble organics: (1) a materials balance technique of extreme precision suited only for research work, and (2) a rapid, mass culture technique of plus or minus 10 percent precision suitable for waste characterization process design, and plant control. The application of thermodynamic concepts derived for reversible reactions at equilibrium to biological reactions which operate at a point remote from equilibrium seems hazardous. Total carbon changes during bio-oxidation provide a significant and useful measure of the reaction and the bio-degradable organic content. The ease and rapidity of the mass culture technique in conjunction with the total carbon analyzer offers an exciting prospect for definitive pollution measurements. (Ellis-Texas)
W71-05031

SUBMERSIBLE RECORDING CURRENT AND WATER QUALITY METERS,
Ontario Water Resources Commission, Toronto.
M. D. Palmer.
Water and Sewage Works, 1970 Reference Number, Vol 117, p R64-R70, November 28, 1970. 7 p, 5 fig, 1 tab, 8 ref.

Descriptors: *Water quality, *Currents (Water), *Lake Erie, *Data collections, *Instrumentation, Hydrologic data, Model studies, Computer models, Chemical analysis, Current meters, Electronic equipment, On-site tests, Telemetry, Flow rates, Water yield, Water resources, Water measurement.
Identifiers: Water intakes, Waste outfalls.

Some applications for water management based upon information gathered from a small completely self-contained submersible water quality meter and a recording current meter operated on Lake Erie at Nanticoke are discussed. Statistical methods of interpreting the data are described and it was concluded that the utilization of recording meters in the nearshore areas of lakes provides the necessary data for a computer model which will indicate: (1) The best location for water intakes and waste outfalls from the dilution point-of-view; and (2) The acceptable discharge concentrations and flows on the basis of not exceeding desirable values at locations in the proximity of the discharge point on a probability basis. (Woodard-USGS)
W71-05084

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1965, PARTS 12-16.
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W71-05089

COLORIMETRIC DETERMINATION OF DISSOLVED OXYGEN AT LOW CONCENTRATIONS,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02K.
W71-05108

SPECTROPHOTOMETRIC DETERMINATION OF HYDROGEN SULFIDE IN NATURAL WATERS,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02K.
W71-05109

A TEST SIMULATION OF THE TEMPERATURES OF THE DEERFIELD RIVER,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05B.
W71-05128

ENVIRONMENTAL MONITORING - BRITISH POLICY AND PROCEDURES,
United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch.
H. J. Dunster.
International Atomic Energy Agency Symposium on Environmental Aspects of Nuclear Power Stations, New York, August 10-14, 1970. Preprint SM-146/25. 6 p, 2 tab, 9 ref.

Descriptors: *Monitoring, *Thermal pollution, *Environment, Radioisotopes, Powerplants, Pollutant identification.
Identifiers: *United Kingdom, *Surveillance programs, Sulfur dioxide, Ash.

Monitoring of the environment is one of the techniques used in assessing the significance of releases of potential pollutants and maintaining control over such releases. The British policy on these monitoring programs is summarized and illustrated by examples of surveys for radioactive materials, thermal effects, sulfur dioxide and dust. The discharge of waste from most applications of radioactive materials are small and not likely to increase greatly even in cases of maloperation except for fuel reprocessing plants. It is concluded from 100 surveys that it is very difficult to identify the contribution of sulfur dioxide or dust from the station against the background from other sources. (Upadhyaya-Vanderbilt)
W71-05135

ECOLOGY OF SCHISTOSOME DERMATITIS IN WESTERN AND NORTHERN NEVADA WATERS,
Nevada Univ., Reno. Center for Water Resources Research.
Ronald L. Church.
Available from NTIS as PB-197 854, $3.00 in paper copy, $0.95 in microfiche. Project Report Series, No. 14, August 1969. 15 p, 9 ref, 3 append. OWRR Project A-027-NEV (1).

Descriptors: *Fresh water, *Nevada, *Human diseases, *Aquatic animals, *Animal parasites, Invertebrates, Snails, Hosts, Parasitism, Ecology, Life cycles, Animal control, Systematics, Census.
Identifiers: *Disease control, *Schistosome dermatitis, *Schistosomes, Flukes.

Human dermatitis caused by schistosome flukes has been periodically reported from Nevada waters. The dermatitis-causing schistosomes are parasites of some species of freshwater snails, and a survey of freshwater snails of western and northern Nevada was made. Both a bibliography and a taxonomic name list for freshwater snails of western and northern Nevada are appended to this report, along with a catalogue of snails collected and preserved, giving localities, number and dates. Living snails were kept in aquaria for several weeks at a time and carefully observed for evidences of schistosome parasites, but none were observed. Examinations of voles and muskrats likewise produced no schistosomes. Further research was indicated. Expanding use of waters for recreation may expose more people to schistosome dermatitis, and more information is needed in order to control outbreaks effectively. (Yensen - Arizona)
W71-05194

DON'T BE HALF-SAFE--THE CURRENT REVOLUTION IN BIOASSAY TECHNIQUES,
Kansas Univ., Lawrence. Dept. of Zoology.
John Cairns, Jr.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Engineering Bulletin of Purdue University, Vol L, No 2, p 559-567, March 1966. 5 fig, 13 ref.

Descriptors: *Bioassay, *Analytical techniques, Bioindicators, *Pollutant identification, Toxicity, Water analysis, Lethal limit, Oxygen, River systems.

There are many more bioassay techniques available than are being used and failure to make full use of these is the result of our attitude towards our river systems rather than becuase of any inherent faults in the techniques themselves. Examples of techniques available for fish are oxygen consumption, cruising speed, acetylcholine esterase concentration, embryonic development, and histological changes. A cooperative approach which would provide maximum information at the least cost and permit the fullest reasonable industrial use of a river system as well is called for. (Ellis-Texas)
W71-05288

STANDARD METHODS FOR DETERMINATION OF RELATIVE TOXICITY OF OIL DISPERSANTS AND MIXTURES OF DISPERSANTS AND VARIOUS OILS TO AQUATIC ORGANISMS,
Federal Water Pollution Control Administration, Washington, D.C. National Marine Water Quality Lab.
For primary bibliographic entry see Field 05C.
W71-05332

5B. Sources of Pollution

ANALYSIS OF THE USE OF DISTORTED HYDRAULIC MODELS FOR DISPERSION STUDIES,
California Univ., Berkeley. Dept. of Civil Engineering; and Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W71-04853

NUTRIENTS IN STREAMS DRAINING WOODLAND AND FARMLAND NEAR COSHOCTON, OHIO,
Agricultural Research Service, Beltsville, Md. Soils Lab.
A. W. Taylor, W. M. Edwards, and E. C. Simpson.
Water Resources Research, Vol 7, No 1, p 81-89, February 1971. 9 p, 3 fig, 6 tab.

Descriptors: *Nutrients, *Runoff, *Forests, *Farms, *Ohio, Nitrogen, Nitrates, Phosphates, Potassium, Data collections, Water quality, Path of pollutants, Eutrophication, Appalachian Mountain Region, Farm wastes, Statistical methods, Fertilizers, Leaching, Water pollution sources.
Identifiers: Woodlands, Farm lands, Coshocton (Ohio).

Nitrogen, phosphate, and potassium concentrations were measured in streams draining woodland and farmland watersheds at Coshocton, Ohio 1966 through 1969. Temporal variations in the nutrient concentrations were much smaller than the changes in the rate of streamflow. No relationship was found between any nutrient concentration and streamflow, and no seasonal changes in concentration were detected. Nutrient losses from farmland were significantly greater than those from woodland. The nitrate-N concentration in the farm runoff was below 2 ppm except for one short period when it rose to 10 ppm. The input of nitrogen in the rain was greater than the loss in runoff from both watersheds. The average concentration of phosphate in runoff was 22 ppb (of P) from the farm and 15 ppb from the woodland. The analysis of the data shows that total nutrient losses cannot be calculated meaningfully unless both hydrologic and chemical data are available. The volume of water flow is the most important variable in this calculation. (Knapp-USGS)
W71-04856

MODEL OF HYDROLOGIC REDISTRIBUTION OF RADIONUCLIDES AROUND NUCLEAR-EXCAVATED SEA-LEVEL CANALS,
Isotopes, Inc., Palo Alto, Calif. Palo Alto Labs.
R. L. Charnell, D. E. Holly, and P. R. Fenske.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970; Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/51, p 801-814, 1970. 14 p, 5 fig, 14 ref. USAEC Contract AT (26-1)-171.

Descriptors: *Radioecology, *Fallout, *Leaching, *Path of pollutants, *Nuclear engineering, Nuclear explosions, Canals, Canal construction, Groundwater movement, Infiltration, Navigation, Seepage.
Identifiers: *Venezuela, *Nuclear canal excavation.

As part of the bioenvironmental and radiological-safety feasibility studies for nuclear excavation of a sea-level canal in Central America, a model was developed to estimate the rate at which excavation-produced radionuclides are redistributed by natural hydrologic processes. The model can be used to estimate the amount of a specific radionuclide available for interaction with plant, animal, or man. The model was formulated for two distinct regions: in the canal channel itself and the region away from the canal where dust and fine particles are deposited as wind-distributed fallout. For the fallout zone portion of the model, redistribution is controlled by the initial removal by rainwater leaching. The amount of radionuclide which is removed with rainfall is represented by the simple distribution coefficient Kd). Once the nuclide is dissolved, its rate of entry into the groundwater reservoir and into the stream can be determined from soil density and porosity, long-term infiltration rates, and some pre-excavation hydrologic data. This model was applied to two of the proposed canal sites in Panama and Colombia. For radionuclides with distribution coefficients higher than 100, concentration of the radionuclide in river water continues at a near constant level decreased only by radioactive decay. Removal from the land surface by leaching is not significant during the first year following excavation. On the other hand, for nuclides with distribution coefficients less than 100, leaching removal from the land surface is significant in one year and the concentration in streams drops rapidly. (Knapp-USGS)
W71-04882

DISTRIBUTION AND MIGRATION OF LEAD IN GROUND WATERS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
G. A. Goleva, V. A. Polyakov, and T. P. Nechayeva.
Translated from Geokhimiya, No 3, p 344-357, 1970. Geochemistry International, Vol 7, No 2, p 256-268, 1970. 13 p, 4 fig, 5 tab, 18 ref.

Descriptors: *Water chemistry, *Leaching, *Heavy metals, Oxidation, Acid mine water, Sulfides, Sulfates, Ion transport, Mine water, Mine acids, Solubility, Water pollution sources, Path of pollutants, Solutes.
Identifiers: *Lead.

Anomalous lead contents in natural waters are related to oxidation of Pb-bearing sulfide deposits or leaching from rocks by chloride and bicarbonate waters. Maximum lead contents of 3-5 mg/liter are found in mine waters on deep-seated thermal fluids. In solution Pb forms important complex ions with each of the principal anions in natural waters. Migration of lead is limited in sulfate solutions by the low solubility of sulfate compounds, and in alkaline waters by precipitation of Pb (OH)2. Lead forms a number of stable metal-organic complexes, and is readily sorbed from solution as positively charged complexes. Hydrochemical lead anomalies are restricted and are among the best indicators of sulfide ore deposits. (Knapp-USGS)
W71-04894

BIOGEOCHEMICAL INVESTIGATIONS IN THE RUDNYY ALTAY,
Akademiya Nauk SSSR, Moscow. Institut Geokhimii i Analiticheskoi Khimii.
For primary bibliographic entry see Field 02K.
W71-04895

EFFECTS OF MANURE DEPTH ON RUNOFF FROM SOUTHWESTERN CATTLE FEEDLOTS,
Texas Tech Univ., Lubbock.
L. L. Keeton, W. Grub, D. M. Wells, G. F. Meenaghan, and R. C. Albin.
Paper presented at the 1970 winter meeting American Society Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-910. 7 p, 2 tab, 1 ref.

Descriptors: *Rainfall intensity, *Rainfall-runoff relationships, Farm wastes, Pollutants, Moisture content, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment, Water pollution sources.
Identifiers: Feedlot runoff, Feedlot slope, Water holding capacity.

With the increasing number of beef cattle in feedlots in the Southwestern United States has come a major water pollution problem. The effects of manure accumulation on quantity and quality of runoff from concrete and direct surfaced feedlots for various precipitation rates were determined. A relatively dry manure pack holds approximately one-half inch of rainfall per inch of manure depth. If runoff from a relatively dry mass occurs, large quantities of suspended and dissolved pollutants are carried off. Manure at 60 percent moisture minimizes the pollutants removed during feedlot runoff. The quality of feedlot runoff is primarily a function of the moisture content of the manure, the rainfall intensity, and the feedlot slope. (Christenbury-Iowa State)
W71-04913

CATTLE WASTES - POLLUTION AND POTENTIAL TREATMENT,
Kansas Univ., Lawrence. Dept. of Civil Engineering; and Kansas Univ., Lawrence. Environmental Health Engineering Lab.
For primary bibliographic entry see Field 05D.
W71-04916

WATER QUALITY CHARACTERISTICS OF THE NEW HOPE AND LOWER HAW RIVERS JULY 1966 - FEB. 1970 WITH ESTIMATES OF THE PROBABLE QUALITY OF NEW HOPE LAKE,
North Carolina Water Resources Research Inst., Raleigh; and North Carolina Univ., Chapel Hill. Dept. of Environmental Biology.
Charles M. Weiss.
Available from NTIS as PB-197 720, $3.00 in paper copy, $0.95 in microfiche. North Carolina Water Resources Research Institute Report No. 48, January 1971. 139 p, 5 tab, 24 fig, 23 ref, 4 append. OWRR Project B-007-NC (2).

Descriptors: *Eutrophication, *Limnology, Waste assimilative capacity, Hydrogen ion concentration, *Water pollution effects, *Water quality, North Carolina, *Water pollution sources, Lakes, Oxygen requirements, Oxygen demand, *Sampling, Temperature, Turbidity, Conductivity, Dissolved oxygen, Nitrogen, Phosphorous, Chlorophyll, Biochemical oxygen demand.
Identifiers: New Hope Reservoir, New Hope River, Haw River, Oxygen balance, Waste water loading, Residues, Oxygen saturation, Index organisms.

The water quality characteristics of the lower Haw River (Saxapahaw to the juncture with the New Hope River) and the New Hope River (downstream of Chapel Hill and Durham) have been evaluated on the basis of 19 water quality parameters. The stations on the New Hope River were sampled in the period July 1966 - February 1970 and the Haw River from December 1967 to February 1970. Projections, based on the estimates of the quality of the two river systems have been made of the probable water quality that might be expected in the New Hope Lake. Although water quality degrading materials transported by the Haw River are greater by factors of 5 to 7 times that of the New Hope, the oxygen balance in the Haw River at the location of the new lake indicates that the upstream contributions of oxygen consuming materials have been essentially stabilized and the oxygen resources of the Haw River are near normal. In contrast, although the New Hope River transports a substantially smaller pollution load in terms of quality degrading materials per unit of time, oxygen assets have not recovered to the same extent as in the Haw. Due to longer detention times, it is estimated that the overall quality of the waters in the new impoundment will be controlled primarily from pollution from the New Hope drainage. (Howells-North Carolina)
W71-04932

ESTIMATING POPULATION EXPOSURE TO SELECTED METALS - MANGANESE,
Research Triangle Inst., Durham, N.C.
W. Kenneth Poole, and Donald R. Johnston.
Available from NTIS as PB-195 834, $3.00 in paper copy, $0.95 in microfiche. Report No NIH-ES-2433, Oct 1969. 165 p, 10 fig, 46 tab, 85 ref. Contract No PH-86-65-109.
Identifiers: *Public health, *Manganese, *Air pollution, Manganese, *Food contamination, *Water pollution, *Occupational diseases, Industrial wastes, Bibliographies, Reviews, Electric batteries, Manganese modules, Metalliferous minerals, Mining, Metal working, Dry cells, Welding rods, Agricultural wastes, Exposure, Steel industry, Manganese steels.

The report is intended to cover the following aspects of manganese in the environment: the flow of manganese from the time it is mined or imported until it is consumed; the 'exposure' of sub-populations occupationally exposed to manganese (i. e., persons handling manganese in one or more of its forms); and the 'exposure' of the general population to manganese via air, food, water, or otherwise. It also includes selected abstracts on chronic poisoning, occupational exposure and biological effects.
W71-04947

ESTIMATING POPULATION EXPOSURE TO SELECTED METALS - TITANIUM,
Research Triangle Inst., Durham, N.C.
W. Kenneth Poole, and Donald R. Johnston.
Available from NTIS as PB-195 819, $3.00 in paper copy, $0.95 in microfiche. Report No NIH-ES-2434, March 1969. 101 p, 8 fig, 23 tab, 50 ref. Contract No PH-86-65-109.
Identifiers: *Titanium, *Public health, *Food contamination, Titanium, *Industrial medicine, *Air pollution, *Water pollution, Exposure, Toxicity, Rutile, Mining, Pigments, Welding rods, Titanium alloys, Titanium dioxide, Metal working, Environmental surveys, Lung.

The report is intended to cover the flow of titanium from the time it is mined until it is consumed; the exposure of sub-populations occupationally exposed to titanium; and the exposure of the general population to titanium via air, food and water. Occupational exposure to titanium in the air has been found to be virtually absent. Apart from open pit operation, the mining industry has no significant exposure problem. Among manufactureres using titanium concentrates, pigment plants and titanium metal plants have been suggested as sources of possible excessive exposure. Food appears to be the most significant source of titanium exposure to the general population. Estimated daily titanium dose from a typical diet is 607microgram. Normal water intake is 3 microgram.
W71-04948

PARTICULATE ORGANIC MATTER IN KANEOHE BAY, OAHU, HAWAII,
Hawaii Inst. of Geophysics, Honolulu.
For primary bibliographic entry see Field 02L.
W71-04949

STATUS OF SALT-WATER ENCROACHMENT IN 1969 IN SOUTHERN NASSAU AND SOUTHEASTERN QUEENS COUNTIES, LONG ISLAND, NEW YORK,
Geological Survey, Mineola, N.Y.
For primary bibliographic entry see Field 02L.
W71-04976

VERTICAL MOLECULAR DIFFUSION OF XENON-133 GAS AFTER INJECTION UNDERGROUND,
Geological Survey, Idaho Falls, Idaho.
John B. Robertson.
For sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D287-D300, 1970. 14 p, 8 fig, 2 tab, 10 ref.

Descriptors: *Diffusion, *Path of pollutants, *Nuclear wastes, *Tracers, *Radioactivity techniques, Aquifers, Idaho, Distribution patterns, Injection wells, Waste disposal, Radioactive wastes, Playas.
Identifiers: Gas diffusion, Xenon radioisotopes, *Waste disposal wells.

Nine hundred and eighty-seven curies of radioactive Xe-133 gas mixed with 28,300 cu m of air was injected rapidly into permeable basalt strata at the National Reactor Testing Station, Idaho. A capping layer of fine-grained playa sediments confined the gas underground. The subsurface Xe-133 was monitored by Geiger-Mueller detectors and by air samples from observation wells surrounding the injection well. Most of the Xe-133 apparently remained underground and decayed radioactively. Molecular diffusion rates of Xe-133 from the ground were estimated using a simplified mathematical model. A maximum flux rate of 2,560 microcuries/hr from a ground-atmosphere interface area of 26,700 sq m was calculated for the first day after injection. The estimated rates indicated a total diffusion loss of 0.37 c for the total area during the 26-day observation period. The calculated rates had fairly good agreement with the measured flux rates at the ground surface. Erratic variations in the measured flux rates were attributed to other influences such as barometric-pressure changes. (Knapp-USGS)
W71-04977

MIGRATION OF POLLUTANTS IN A GLACIAL OUTWASH ENVIRONMENT,
Washington State Univ., Pullman.
James W. Crosby, III, Donald L. Johnstone, and Robert L. Fenton.
Water Resources Research, Vol 7, No 1, p 204-208, February 1971. 5 p, 5 fig, 11 ref. OWRR Project B-005-WASH (3).

Descriptors: *Path of pollutants, *Glacial drift, *Farm wastes, *Confinement pens, Coliforms, Nitrates, Nutrients, Solutes, Soil water movement, Groundwater, Washington, Water pollution sources, Chlorides, Soil moisture.
Identifiers: FeedlotsCattle), Outwash (Glacial).

A test drilling program was conducted at a dairy in the Spokane Valley, Washington, to determine the effects of feedlot operation on groundwater quality. Coliform bacteria, enterococci, and fecal coliforms were found to disappear within a relatively few feet of the ground surface. Chlorides and nitrates, however, were persistent in depth and may actually reach the groundwater body. The low natural moisture content of the soil, coupled with the apparent high moisture tensions, suggests that soil moisture is not presently moving downward in the system. It is concluded that the downward migration of inorganic chemicals from the feedlot environment must represent an early phase of the operation, which is arrested as organic mattes are formed in near-surface layers. (Knapp-USGS)
W71-05046

HYDROLOGIC IMPLICATIONS OF SOLID-WASTE DISPOSAL,
Geological Survey, Washington, D.C.
William J. Schneider.
Free on application to the US Geological Survey, Wash, DC 20242. Geological Survey Circular 601-F, 1970. 10 p, 2 fig, 2 tab, 7 ref.

Descriptors: *Water pollution sources, *Urbanization, *Solid wastes, *Waste disposal, Surface wasters, Groundwater, Garbage dumps, Landfills, Waste dumps, Water pollution, Precipitation (Atmospheric), Seepage, Infiltration, Groundwater movement, Hydraulics, Surface runoff, Streams, Soil types, Permeability, Floods, Evaluation, Planning.
Identifiers: *Urban hydrology.

The disposal of more than 1,400 million pounds of solid wastes in the United States each day is a major problem. Four disposal methods-open dumps, sanitary landfill, incineration, and onsite disposal-carry an inherent potential for pollution of water resources. Seepage of rainwater through the wastes leaches undesirable constituents which reach the groundwater in the area. This leachate is generally both biologically and chemically contaminated. Pollution potential is highest in permeable areas with a shallow water table where the wastes are in direct contact with the groundwater. Site selection for disposal of solid wastes must be based on adequate water-resources information if pollutional potential is to be minimized. This will require regional as well as localized data on the water resources of the area. Only through such an approach can adequate protection be afforded to the environment in general and the water resources in particular. (Woodard-USGS)
W71-05094

A TEST SIMULATION OF THE TEMPERATURES OF THE DEERFIELD RIVER,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
R. T. Jaske.
USAEC Contract at (45-1)-1830. AEC Research and Development, Report No BNWL-628, UC-80, Dec 1967. 41 p, 9 fig, 3 tab, 6 ref.

Descriptors: *Thermal pollution, *Temperature, Forecasting, Density, Flow profiles, Meteorological data, Massachusetts, Water pollution sources.
Identifiers: *Deerfield River, COL HEAT simulation system, Thermal discharge, Advected heat, Travel time, Currents.

Two test simulations involving adaptation of the digital simulation system were performed using actual data collected in two sidely differing drainage basins. The report summarizes the results of the Deerfield simulation. It uses temperature records collected by the New England Power Company during the period of 1960 through 1963. It is concluded that the COL HEAT simulation system is generally adequate to represent the water temperature regime of the Deerfield River within the accuracy of the input data presented for evaluation. The data required for operation of the temperature model are water temperature at the inlet and outlet end, form of discharge at the outlet, meteorological parameters, river or reservoir dimensions reduced to equivalent non-parallel trapezoidal cross sections, and advected heat quantities. A hypothetical thermal discharge of 300 MW directly into the river was performed as an exercise in predictive capability of the model. The results indicate that from 10 to 30 percent of this heat would remain during the summer months and 40 to 60 percent during the cooler months in the river at a station 27 miles below the hypothetical discharge point. (Upadhyaya-Vanderbilt)
W71-05128

HEATED DISCHARGE FROM FLUME INTO TANK,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
Heinz Stefan, and Frank R. Schiebe.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA6, Paper 7762, p 1415-1433, December 1970. 15 fig, 9 ref.

Descriptors: *Thermal stratification, *Impoundments, *Outlets, *Dispersion, Water quality, Water temperature, Froude number, Reynolds number, Water pollution sources, Flumes.
Identifiers: *Thermal discharges, Velocity distribution, Tethered-sphere method.

Information obtained in laboratory experiments is given on the physical processes producing temperature and velocity distributions when heated water is discharged from a channel into a wide, deep impoundment. Both the outlet channel and the receiving tank in the experiments had rectangular cross sections, but the tank was more than 10 times wider and deeper than the channel. The tethered-sphere method was developed to measure local velocities; local temperatures were also measured and surface spreading patterns were recorded photographically. Investigated densimetric Froude numbers and Reynolds numbers at the outlet ranged from 0.6 to 7.2 and from 1500 to 9600, respectively. (Oleszkiewicz-Vanderbilt)
W71-05132

SOME CHARACTERISTICS OF THE THERMAL REGIME OF RIVERS IN THE DANUBE AND DNIESTER BASINS,
Ukrainskii Nauchno-Issledovatelskii Gidrometeorologicheskii Institut, Kiev (USSR).
For primary bibliographic entry see Field 02E.
W71-05141

THE CHENA RIVER, THE STUDY OF A SUBARCTIC STREAM,
Federal Water Quality Administration, College, Alaska. Alaska Water Lab.
Paul J. Frey, Ernst W. Mueller, and Edward C. Berry.
Available from NTIS as PB-197 857, $3.00 in paper copy, $0.95 in microfiche. October 1970. 96 p, 14 fig, 26 tab, 57 ref. FWQA Project No 1610–10/70.

Descriptors: Benthos, Chemical oxygen demand, Coliform, *Dissolved oxygen, Diversification, Fisheries, *Flood control, Freezing, Nutrients, Plankton, Water pollution sources, Reaeration, Sewage, Temperature, *Water quality, Water pollution effects, *Alaska, Subarctic, Flow.
Identifiers: *Chena River (Alas), Fairbanks (Alas), Break-ups, *Subarctic streams.

The Chena River is a subarctic stream flowing westerly from the low mountains of eastern Alaska to the Tanana River near Fairbanks. It is typical of many Interior Alaska rivers with the exception that its lower reaches are highly polluted by domestic and industrial wastes from the Fairbanks area. The purpose of this 3-year study of the river was to understand the physical, chemical, and biological limnology of the river system and what effect man's influence--past, present and future--has on the river. Dissolved oxygen was one of the most critical parameters determined. In the summer it is close to saturation. During winter, in the lower river, the concentration approaches 1 mg/l. The biological community was studied through both quantitative and qualitative plant and animal collections. The upper reaches of the river are much richer in number of kinds of organisms than the lower reaches. Coliform bacteria counts range from very low in the upper river to over 500,000 per 100/ml below Fairbanks. A flood control dam is planned for the river above the city of Fairbanks. Significant modification of the water quality and biota of the river can be expected following the construction of the dam. Proper management of the flow from the impoundment can reduce the objectionable effects of this dam on the river system.
W71-05143

OCEANOGRAPHIC OBSERVATIONS OF OIL SLICKS DURING THE CHEVRON SPILL, MARCH, 1970,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
Stephen P. Murray, William G. Smith, and Choule J. Sonu.
Available from NTIS as AD-714 260, $3.00 in paper copy, $0.95 in microfiche. Technical Report No 87, Sept 1970. 106 p, 34 fig, 6 tab, 37 ref. ONR Project NR-388002.
Identifiers: *Water pollution, *Oils, *Estuaries, *Mexico Gulf, Water pollution, Wind, Water waves, Interactions, Tides, Seacoast, Temperature, Salinity, Deltas, Density, Predictions, Data processing systems, Diffusion, Statistical data, Petroleum, Mississippi, Petroleum industry, *Oil slicks, *Oil pollution, Mississippi River, *Oil wells, Blowouts, Oceanographic data.

Oceanographic observations near the Chevron spilling well off the Mississippi Delta in March 1970, revealed relative roles of various physical factors of the regional estuarine system in the behavior of oil slicks. Surface stress from the wind was most important; at speeds above 15 mph the slick orientation was generally determined by the wind direction. The wind also indirectly affected oil which was sunk by dispersant in that wind waves promoted mixing, which in turn affected the vertical stability, hence eventually the velocity profile. Wind setups and setdowns were correlated with downward and upward isopycnal movements, respectively. Both calculations and observations showed that tidal currents produced an L-shaped slick geometry when winds were below about 15 mph. The diurnal rotation of the tidal currents served to limit the excursion length of oil from the source, keeping it short of the nearest shore. The presence of fresh water from the Mississippi River in the surface layer and the consequent development of convergence lines often formed a natural barrier, preventing oil from encroaching upon the shore. Theoretical analysis using turbulent diffusion theory disclosed that the area and length of a steady-state oil slick increased with oil discharge but decreased with current speed and the lateral diffusion coefficient.
W71-05148

INDUSTRIAL USE OF SURFACE WATERS IN ILLINOIS,
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 03E.
W71-05166

BIOMONITORING OF INDUSTRIAL EFFLUENTS,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
Herbert W. Jackson, and William A. Brungs, Jr.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, March 1966, p 117-124. 2 fig, 13 ref.

Descriptors: *Biota, *Industrial wastes, *Effluents, Aquatic life, *Toxicity, Biology, Microbiology, Water pollution sources.
Identifiers: *Biomonitoring, Aquarium.

This system allows for continuous surveillance over the toxicity of an effluent and has the following objectives: (1) to demonstrate the continuous suitability of an effluent for aquatic life provided slow-acting or cumulative toxins are not involved; (2) to detect change in the biological acceptability of the effluent itself; and (3) to detect change in the effect of effluent on the biota of the receiving waters. Objective 1 can be accomplished through the use of an aquarium but objectives 2 and 3 are considerably more difficult. A single basic design of exposure tanks and a flow plan are presented as a means to accomplish objectives 2 and 3. Effluent supply, dilution water, proportioning of flow and test animals are discussed to enhance the ideas presented. (Ellis-Texas)
W71-05170

PROCEEDINGS, CONFERENCE ON HAZARDOUS CARGOES, U. S. COAST GUARD ACADEMY, NEW LONDON, CONNECTICUT ON 8-9 JULY 1970.
National Research Council, Washington, D.C. Committee on Hazardous Materials.

Available from NTIS as PB-195 685, $3.00 in paper copy, $0.95 in microfiche. August 1970. 251 p.
Identifiers: *Hazardous materials, Meetings, *Cargo transportation, Hazardous materials, *Information systems, Cargo ships, Petroleum, Pesticides, Chemical reactions, Information centers, Public health, Chemical industry, Transportation.

Contents: Cargo mixing possibilities and preventive measures; Problems and preventive measures of chemical reactions as seen by the engineering, supervisory, and operating teams in the chemical industry; Classification of reactive chemicals; Evaluation of chemical stability; Chemical industry transportation emergency information systems; A pesticide safety team network program; The operation of a specialized scientific information and data analysis center with computerized storage and associated transmission network; The DOT casualty reporting system; Proposed special topics program as related to hazardous materials in the Coast Guard Academy curriculum; Casualty review and analysis in the Coast Guard; A maritime safety management information system; The Coast Guard program for an information system on hazardous materials; Prospects for a national information system for hazardous materials.
W71-05260

TRANSPORT ANALYSIS-BASIC PREDICTIVE APPROACH OF THE MOVEMENT OF POLLUTANTS THROUGH SOIL,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
D. B. Cearlock.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 516-526, March 1966. 5 fig, 8 ref. US Atomic Energy Commission Contract AT (45-1)-1830.

Descriptors: *Soil water movement, Diffusion, Darcy's Law, Dispersion, Convection, Biological, Chemical, Physical, *Path of pollutant, Water pollution sources.
Identifiers: *Transport analysis, Macroscopic, Miscroscopic.

To insure applicability of one-dimensional laboratory investigations to multi-dimensional field problems, two phenomena, fluid movement and pollutant reactions, were investigated separately and equations were developed to predict pollutant transport through soil. The fluid movement component of the transport equation groups together all mechanisms that transport the pollutants such as convection, diffusion, and dispersion. The reaction component includes all reactions that occur between the pollutant and its environment such as biological, chemical, and physical aspects. (Ellis-Texas)
W71-05264

SUMMARY OF OUR PRESENT KNOWLEDGE OF THE PHYSICAL PROCESSES OF MIXING IN THE OCEAN AND COASTAL WATERS, AND A SET OF PRACTICAL GUIDELINES FOR THE APPLICATION OF EXISTING DIFFUSION EQUATIONS IN THE PREPARATION OF NUCLEAR SAFETY EVALUATIONS,
Atomic Energy Commission, Washington, D.C., AND Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Institute.
For primary bibliographic entry see Field 02L.
W71-05324

5C. Effects of Pollution

EUTROPHICATION,
Wisconsin Univ., Madison. Water Resources Cneter.
G. Fred Lee.
Available from Ntis as PB-197 697, $3.00 in paper copy, $0.95 in microfiche. Wisconsin Univ, Madison, Water Resources Center, Eutrophication Information Program Occasional Paper No 2, 1970. 39 p, 1 fig, 2 tab, 37 ref. OWRR Project W-117 (No 1614) (2).

Descriptors: *Eutrophication, *Lakes, *Water pollution sources, *Water pollution control, Water quality, Pollution abatement, Nutrients, Phosphorus, Nitrogen, Classification, Measurement, Trophic level.
Identifiers: Eutrophication classification, Eutrophication measurement, Lake classification.

The eutrophication process is described giving lake characteristics and classification. Causes of eutrophication are discussed, including factors influencing aquatic plant production, types of aquatic plant nutrients, together with concentration and sources of nitrogen and phosphorus, which include domestic and industrial waste waters, urban and agricultural drainage and natural sources; the role of lake sediments, atmospheric sources, groundwaters, marshes, and nitrogen fixing bacteria and their interaction with nitrogen and phosphorus sources are outlined. The parameters to be considered in measurement of eutrophication are evaluated. Effect of eutrophication on domestic, industrial, and recreational uses of water are outlined. A summary of methods used in reducing and controlling effects and rate of eutrophication includes nutrient removal from waste waters, waste water diversion, dredging, flushing, chemical and biological control of nuisance plant growth, harvesting, lake aeration, control of agricultural sources of nutrients and control of urban drainage, hypolimnetic withdrawal, water level management, and immobilization of nutrients. (Auen-Wisconsin)
W71-04909

AIR POLLUTANTS AFFECTING THE PERFORMANCE OF DOMESTIC ANIMALS - A LITERATURE REVIEW.
Agriculture Research Service, Washington, D.C.

For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $1.00. Agriculture Handbook No 380, Issued August 1970. 109 p, 666 ref.

Descriptors: *Domestic animals, *Air pollution effects, *Toxicity, Pollutant identification, Air pollution, Atmsophere, Smoke, Pollutants, Physiological Ecology, Legislation, Farm wastes, Laboratory studies, *Reviews, *Bibliographies, Water pollution effects.
Identifiers: Inhalation, Ingestion, Veterinary diagonosis, Esthetic effects, Automobile exhausts.

The results of a Literature Survey to determine the effects of air pollution on domestic animals is presented. The term 'domestic animals' as used in this report includes cattle, sheep, goats, swine, horses, chickens, turkeys, ducks, geese, pigeons, Japanese quail, dogs, cats, rabbits, and honey bees. Chapters 2, 3, and 4 on air pollution, smoke, and automobile exhausts provide a brief background on the generalities of these pollutants and their effects on domestic animals. Many of the specific air pollutants found in the air, smoke, and automobile exhausts are described in subsequent chapters, which contain a brief introduction of the air pollutant, the published results, a summary, and a bibliography. (Christenbury-Iowa State)
W71-04910

BOVINE SALMONELLOSIS (S. TYHIMURIUM) IN A FEEDLOT OPERATION,
For primary bibliographic entry see Field 05F.
W71-04918

BOVINE SALMONELLOSIS ASSOCIATED WITH CONTAMINATED CREEK WATER AND HUMAN INFECTION,
Kansas State Univ., Manhatton. Coll. of Veterinary Medicine.
For primary bibliographic entry see Field 05F.
W71-04919

OBSERVATIONS ON THE EFFECT OF THE RE-USE OF BROILER LITTER ON THE INCIDENCE OF MAREK'S DISEASE,
Delaware Univ., Newark.
G. W. Chaloupka, R. W. Lloyd, J. F. Gordy, and L. M. Greene.
Poultry Science, Vol 47, p 1660, 1968.

Descriptors: *Farm wastes, *Condemnation, *Poultry, *Disinfection, Public health, Pollution abatement, *Diseases.
Identifiers: *Marek's disease, Broiler house, Litter re-use, Leucosis, Immunity, Causative agent.

Four different studies involving several trials have been conducted at the University of Delaware Substation in which the performance of broilers grown on re-used litter was compared to those grown on new litter. These studies over a period of several years have shown that broiler condemnations due to leucosis have in most instances been lower for the broilers grown on re-used litter. This substantiates the findings of many field studies and by at least one private research farm. These results would indicate that a failure to clean out and disinfect the broiler house before placing each new lot of chicks is not a primary factor in increasing the incidence of Marek's disease. It is not known whether these results are due to developing a partial immunity due to contact with the causative agent in the litter at an early age, or whether the causative agent is destroyed in some way in the reused litter. (White-Iowa State)
W71-04927

WATER QUALITY CHARACTERISTICS OF THE NEW HOPE AND LOWER HAW RIVERS JULY 1966 - FEB. 1970 WITH ESTIMATES OF THE PROBABLE QUALITY OF NEW HOPE LAKE,
North Carolina Water Resources Research Inst., Raleigh; and North Carolina Univ., Chapel Hill. Dept. of Environmental Biology.
For primary bibliographic entry see Field 05B.
W71-04932

BIOLOGICAL PRODUCTIVITY OF THE COEUR d'ALENE RIVER AS RELATED TO WATER QUALITY, (THE ACUTE TOXICITY OF ZINC TO CUTTHROAT TROUT-SALMO CLARKI),
Idaho Univ., Moscow. Dept. of Biological Science; and Idaho Univ., Moscow. Water Resources Research Inst.
F. W. Rabe, and C. W. Sappington.
Available from NTIS as PB-197 736, $3.00 in paper copy, $0.95 in microfiche. Idaho Water Resource Research Institute, Completion Report, December 1970. 16 p, 1 tab, 24 ref. OWRR Project A-024-IDA (1).

Descriptors: *Bioassay, *Zinc, *Cutthroat trout, Limnology, Water quality, *Toxicity, Idaho, Productivity, Lethal limit, Water pollution effects, Industrial wastes.
Identifiers: Salmo clarki, Coeur d'Alene River.

Determinations of the acute toxicity of zinc to Cutthroat trout (Salmo clarki) fingerlings were conducted using two bioassay systems. Methyl orange alkalinity of the test water was 23.9 ppm as calcium carbonate. PH values were near neutrality. In a standard, static bioassay, 24, 48 and 96 hr median tolerance limit (TLm) values of 0.62, 0.27 and 0.09 ppm zinc respectively, were obtained. Results of a recirculating, flowing-water bioassay showed a 24 hr TLm value of 0.42 ppm zinc. No 48 or 96 hr values were found due to statistical non-significance of the data. The inconclusiveness of the results of the running system may be due to changes in the concentration of zinc present in the test water as a result of sorption of the zinc ions to the bottom and sides of the test tank. (Rabe-Idaho)
W71-04939

ECOLOGICAL DISTRIBUTION OF PESTICIDES IN LAKE POINSETT, SOUTH DAKOTA,
South Dakota Agricultural Experiment Station, Brookings; and Cooperative Fishery Unit, Brookings; and South Dakota State Univ., Brookings. Dept. of Biochemistry.
Michael R. Hannon, Yvonne A. Greichus, Richard L. Applegate, and Alfred C. Fox.
Transactions of the American Fisheries Society, Vol 99, No 3, p 496-500, 1970. 4 tab, 16 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Chlorinated hydrocarbon pesticide, Distribution, Bottom sediments, Aquatic habitats, Aquatic animals, Aquatic plants, DDT, Ecosystems, Chromotography, Pesticides, Trophic level, South Dakota.
Identifiers: Lake Poinsett (S.D.), Pesticide residues, DDD, DDE.

The distribution was studied of residues of chlorinated hydrocarbons in relation to different ecosystemic components: water, bottom sediments, zooplankton, benthic algae, crayfish, insects, and fish. The residues of DDT and its metabolites DDD and DDE were the highest in all trophic levels. Heptachlor, heptachlor epoxide, aldrin, dieldrin, and lindane were present in the majority of sampled types, and toxaphene in fish. Neither endrin nor metoxychlor was detected. Water had a very

low concentration of residues. In comparison with water the concentration of residues was as follows: bottom sediments and crayfish--18 times higher, zooplankton and benthic algae--37 times, fish--790 times, and aquatic insects--7300 times. No significant difference was found by analysis of variance between fall and spring samplings. (Wilde-Wisconsin)
W71-04958

THE EFFECT OF VARYING AMOUNTS AND RATIOS OF NITROGEN AND PHOSPHATES ON ALGAE BLOOMS,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
Ruth Patrick.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, March 1966, p 41-51. 6 tab, 6 ref.

Descriptors: *Nitrogen, *Phosphates, *Algae, *Eutrophication, Diatoms, Microbiology, Nitrates, Ammonia, Water pollution effects, Waste water treatment, Pennsylvania.
Identifiers: *Glucose, Waterloo Mills (Pa).

A series of experiments was undertaken at the Waterloo Mills Field Research Station to try to determine the effect of nitrogen as nitrates or ammonium and phosphates in varying amounts and ratios on natural communities of diatoms. Some experiments were carried out to determine the effects of adding small amounts of glucose to these enriched waters. Certain species increased in abundance with increases in nitrogen as nitrates and/or a ammonium and with increases in phosphates and some of them with the addition of small amounts of glucose. However, the heavy diatom growths which often occur in streams enriched with effluents from sewage treatment plants did not occur which indicates other factors are important to the growth of diatoms and hence, algal blooms. (Ellis-Texas)
W71-05026

THE EFFECT OF NITRIFICATION OF ORGANIC WASTES ON WATERS IN THE NATURAL ENVIRONMENT-I. EFFECTS OF SEED,
Maine Univ., Orono. Dept. of Civil Engineering.
Barry A. Patrie, K. Keshavan, and Franklin E. Woodard.
Proceedings Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 869-879, March 1966. 4 fig, 6 tab, 13 ref.

Descriptors: *Nitrification, *Nitrates, Dissolved oxygen, Oxygenation, Deoxygenation, Bacteria, Organic wastes, Water pollution effects, Waste water treatment, *Biochemical oxygen demand.
Identifiers: *Nitrogeneous BOD, *Carbonaceous BOD, *Nitrifiers, Seed, Assimilation capacities, Deamination, Deoxygenation, Synthetic waste.

The standard five-day BOD test is questioned as to its reliability in simulating stream conditions. It was previously supposed that BOD progression always followed two distinct steps, the carbonaceous and then the nitrogenous. Observations of stream conditions and laboratory experiments showed that when active nitrifiers are present initially in sufficient numbers, both the carbonaceous and the nitrogenous demand are exerted simultaneously, and the oxygen uptake becomes nearly exponential. Comparisons between raw sewage and synthetic sewage, part seeded with nitrifying bacteria, and part unseeded were made. Average BOD exertion was 11% higher in the seeded bottles than in the unseeded one, and nitrate production ranged as much as 3120% higher in seeded samples than in unseeded samples. These results showed that nitrification was not suppressed by carbonaceous oxidation when sufficient active nitrifiers were present, and that this nitrification was a significant factor in the oxygen depletion of the sample. Therefore, it is imperative that a proper bacterial seed must be selected for the BOD test to avoid serious discrepancy between predicted and actual dissolved oxygen levels in a natural body of water. (Lowry-Texas)
W71-05033

LAKES--RESTORATION AND PRESERVATION,
Federal Water Quality Administration, Cincinnati, Ohio. Field Investigations Branch.
Lowell E. Keup, and Kenneth M. Mackenthun.
Water and Sewage Works, 1970 Reference Number, Vol 117, p R16-R21, November 28, 1970. 6 p, 2 tab, 18 ref.

Descriptors: *Lakes, *Eutrophication, *Aquatic weed control, *Ecology, *Water quality, Preservation, Control, Limnology, Surface waters, Environmental effects, Self-purification, Lake soils, Sedimentation, Methodology, Nutrients, Water pollution, Streamflow, Runoff, Biological treatment, Wastes, Sewage.
Identifiers: *Lake preservation, Plant ecology.

Problems concerned with lake eutrophy and methods of lake restoration and preservation are discussed. The ultimate end of eutrophy is the elimination of a lake or reservoir. Before this end is reached, a number of undesirable conditions develop that are frequently due to increased biological production in the lake. For example, larger standing crops of algae and pond weeds produce undesirable tastes and odors in water to interfere with public supplies and to increase solids that must be removed. When the plant life dies it contributes to deoxygenation, a problem particularly significant in deep waters of stratified lakes where anaerobisis induces increased sulfide, iron and manganese concentrations. Each lake must be examined before its problem can be assessed and preventive measures initiated to check eutrophy. The nutrient that offers the best chance for control with the least side-effects appears to be phosphorus. It can be removed from waste waters with 99 plus percent efficiency by precipitating calcium (lime), iron, aluminum (alum) or copper ions. (Woodard-USGS)
W71-05082

EFFECT OF HANFORD PLANT OPERATIONS ON THE TEMPERATURE OF THE COLUMBIA RIVER, 1964 TO PRESENT,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
R. T. Jaske, and M. O. Synoground.
AEC Research and Development Report, BNWL-1345, UC-70, Nov 1970. 259 p, 48 fig, 38 tab, 79 ref.

Descriptors: Temperature, Forecasting, Least squares method, Reservoirs, Ecology, Computer programs, Instrumentation, Mixing, Radioisotopes, Columbia River, Washington, Oregon, Water pollution effects.
Identifiers: Hanford Plant (Wash).

This study is primarily concerned with the changes in temperature in the Columbia River as a result of dam construction and the Hanford works. Routine radiological aspects are not included. The data was analyzed by means of a nonlinear, maximum likelihood, least squares fit, routine capable of handling non-linearity and saddlepoints reliably. It is concluded that the erection of hydraulic power dams and reservoirs on the Columbia River has had only a minimal effect on the annual mean temperature of the entire system. Studies of the thermal dissipation of reactor effluent indicate that a majority of the heat is dissipated before the confluence of the Snake and the Columbia. Detailed measurements in the Hanford plant effluent mixing zone are described. Concentrations of radionuclides in invertebrate organisms of the river decreased by one or two orders of magnitude during a plant shutdown. A number of reports directly related to this program are itemized in a section of this report. (Upadhyaya-Vanderbilt)
W71-05116

A SURVEY OF CALIFORNIA COASTAL POWER PLANTS,
Federal Water Pollution Control Administration, Portland, Oreg.
For primary bibliographic entry see Field 05G.
W71-05118

EFFECTS OF THERMAL DISCHARGES ON THE MASS ENERGY BALANCE OF LAKE MICHIGAN,
Argonne National Lab., Ill.
J. G. Asbury.
July 1970. 24 p, 27 ref. ANL/ES-1.

Descriptors: *Thermal pollution, *Temperature, Evaporation, *Lake Michigan, *Energy budget, Water balance, Water pollution effects, Lakes.
Identifiers: Thermal discharges, Wind speeds, Exchange coefficients, Advective input.

This report analyzes the impact of man-made thermal discharges on the mass-energy balance of Lake Michigan. The analytical method used is a generalized version of the heat-exchange model developed by Edinger and Geyer for small lakes and cooling ponds. The generalized model should be applicable to large bodies of water. Land-based meteorological data input to the model are corrected for systematic lake-land variation. The lake-wide physical effects of thermal discharges into Lake Michigan are negligible and will continue to be so for the rest of this century. The calculated annual average increase in Lake Michigan water-surface temperature is 1.4..0.4x10 to the minus 3 F per gigawatt of advective input. The associated increase in evaporation water loss is 9..2 cfs per gigawatt input. The model has also been applied to Lake Superior, Horon, Erie, and Ontario. For each of these lakes, the increases in surface temperature are of the same order as for Lake Michigan. (Upadhyaya-Vanderbilt)
W71-05119

AIRBORNE TEMPERATURE SURVEYS OF LAKE MICHIGAN, OCTOBER, 1966 AND 1967,
Michigan Univ., Ann Arbor. Great Lakes Research Div; and Naval Oceanographic Office, Washington, D.C.
For primary bibliographic entry see Field 07B.
W71-05120

MAXIMUM ALLOWABLE CONCENTRATIONS OF MERCURY COMPOUNDS.
Karolinska Institutet, Stockholm (Sweden).

Arch Environ Health, Vol 19, Dec, 1969, p 891-905. 99 ref.

Descriptors: Metals, *Heavy metals, *Toxicity, Standards, Water pollution effects, Human pathology, Epidemiology, Path of pollutants, Diseases, Air pollution.
Identifiers: Maximum allowable concentrations, Human contamination, *Mercury, Mercury pollution.

The report of an International Committee is presented. Permissible limits for mercury are not the same in different countries. They are 0.1 mg/cu m for metallic vapor and inorganic compounds and 0.01 mg/cu m for organic mercury compounds in USA while in USSR, the permissible limits have been stated to be 0.01 mg/cu m for inorganic mercury and 0.005 mg/cu m for alkyl mercury compounds. The deposition of mercury compounds is stated. The article deals further with experimental aspects (absorption, biotransformation and transport, tissue distribution and retention, clinical aspects, chronic exposure, relation between exposure and symptoms, urine mercury, blood mercury, and biochemical changes as an indication of mercury exposure) of inorganic and organic mercury. The toxicity of particular compounds is variable and from this point of view the following categorization is recommended: (1) methyl and ethyl mercury salts, (2) mercury vapor, and (3) inorganic mercury salts. MAC for the three groups

are recommended to be: group (1) 10 microgram Hg/100 ml of blood, group (2) 0.05 mg/cu m, and group (3) 0.01 mg Hg/cu m. (Novotny-Vanderbilt)
W71-05122

CADMIUM POLLUTION IN PERSPECTIVE,
Institute of Public Health, Tokyo (Japan).
Noboru Yamagata, and Itsuzo Shigematsu.
International Symposium on Hydrogeochemistry and Biogeochemistry, September 7-12, 1970, Tokyo, Japan, Preprint. 39 p, 41 ref, 22 tab, 9 fig.

Descriptors: *Metals, Water pollution, *Diseases, Epidemiology, Water quality, Water properties, Water analysis, Polarographic analysis, Spectrophotometry, Toxicity, Human pathology, Water pollution effects, *Heavy metals.
Identifiers: *Cadmium pollution, Mines, Industrial lakes, Chemical vanes.

A brief history of scientific investigations since the manifestation of cadmium poisoning disease up to date is described. Background information on the geochemistry and analytical chemistry of cadmium and the results of surveillances conducted in several districts are given. Characteristic symptoms of 'itai-itai' are listed. Cadmium can be analytically measured by the emission spectrography, polarography, neutron activation analysis, colorimetry, atomic absorption spectrometry. The most sensitive is the atomic absorption. In Japan, it was estimated that man consumes normally 60 micrograms of cadmium/day but in the area of occurrence of 'itai-itai' disease the consumption was more than 600 micrograms/day. The main contributor of the cadmium is foodstuffs, of which above, a half is contributed by rice. (Novotny-Vanderbilt)
W71-05124

PUBLIC OPPOSITION TO NUCLEAR POWER - AN INDUSTRY OVERVIEW,
Atomic Industrial Forum, Inc., New York; and Niagra Mohawk Power Corp., Syracuse, N.Y.
H. G. Slater.
International Atomic Energy Agency Symposium on Environmental Aspects of Nuclear Power Stations, New York, Preprint SM-146/40, August 10-14, 1970, p 15.

Descriptors: *Nuclear powerplants, *Thermal pollution, Environment, Technology.
Identifiers: *Public opinion, Distrust, Polls, Opposition, Controversy.

The public is demonstrating an intense concern for its environment. Most polls on the subject also indicate that the public is by no means as opposed to nuclear power as some critics would have us believe. As recently as five years ago only eight nuclear power reactors had been built in the United States while today there are more than 100 in operation, under construction or on order, representing a total capital investment of $15 billion. Even if more of the public and the press begin recognizing the environment advantages of nuclear power, the controversy around this technology is not likely to disappear, or even diminish. In the press, in much conservationist literature, even in material from some government agencies, the words thermal pollution are invariably linked with the phrase nuclear power. All power plants contributed to the thermal load; present day nuclear plants about 1/3 more than fossil-fueled plants. A major factor in the criticism of the nuclear community is te public's general distrust of the establishment and its credibility. (Upadhyaya-Vanderbilt)
W71-05126

THERMAL WATER HORTICULTURAL DEMONSTRATION PROJECT,
Eugene Water and Electric Board, Oreg; and Vitro, Eugene, Oreg.
Dale E. Bartholomew, Robert W. Bennett, William L. Cole, Rex E. Heide, and James B. O'brien.
1969 Annual Report, February 1970, p 49. 43 fig, 21 tab, 13 ref.

Descriptors: *Thermal water, *Irrigation systems, *Crops, *Frost protection, Experimental farms, Meteorology, Temperature, Humidity, Weather data, Heated water, Water pollution effects.
Identifiers: *Plant cooling, O'brien Farm, Patrick Farm, Heide Farm, Puustinen Farm, Bartholomew/Cole Farm, Bennett Farm.

This project demonstrates how properly managed thermal water from an industrial source can be used advantageously for agricultural irrigation and then returned to its natural source at acceptable temperature levels. The effects of warm water application on crops and attempts to regulate their micro environment are being managed and demonstrated primarily on frost protection, plant cooling and irrigation. It is concluded that thermal energy in warm effluent water can be dissipated by spraying directly to the atmosphere in an agricultural setting. With this dissipation, there was negligible fogging or mist drift to nearby residential areas. Also, the artificially induced warm, moist microclimate on the project did not cause any increase in fungal bacterial problems nor increase the insect infestation. Accidental leaks in the system caused limited flooding of a small area with water at 125F to 130F. Ponding of waters at these temperatures is harmful to bean, peach, apple and nut crops. Soil heating was shown to be beneficial. (Herrera-Vanderbilt)
W71-05127

ENGINEERING SAFETY FACTORS AND THEIR INFLUENCE ON SITING PRACTICES FOR NUCLEAR POWER PLANTS IN THE EUROPEAN COMMUNITIES,
Council of the European Communities, Brussels (Belgium). Industrial Affairs.
W. F. Vinck, H. A. Maurer, and L. Leonardini.
The International Atomic Energy Agency Symposium on Environmental Aspects of Nuclear powerplants, New York, August 10-14, 1970, Typescript. 40 p, 4 tab.

Descriptors: *Sites, *Cooling water, *Safety, Standards, *Thermal pollution, Ecology, Temperature, Accidents, *Nuclear powerplants, Environmental effects.
Identifiers: Oxygen content, Pressure vessel, Core cooling systems, Europe.

The environmental aspects of nuclear powerplants are first of all determined by the conditions of the site, but also by the design and operational conditions of the plant. In general, a site is decided upon by the utility, economic incentives such as load centres and transmission lines and on the basis of technico-economical considerations such as long term provisions for cooling water. A tendency to set even more strict radiological standards, which can be debated, would not affect significantly the development of nuclear power but does also not add to the protection of the public in a significant manner. Recommendations that specify upper temperature limits as well as minimum oxygen content for discharged cooling water, differ from one country to the other within the European community because of differences in local environmental conditions and of incidental discrepencies in regulations. Within the European community, design and engineering for nuclear power comply with the particular site and environmental conditions with which one is confronted. (Upadhyaya-Vanderbilt)
W71-05129

WASTE HEAT AND THE WATER ENVIRONMENT,
Gulf South Research Inst., New Iberia, La.
Julian Hemens.
Chemical Engineering Progress, Symposium Series, Vol 65 (1968) No 97, p 47-50. 4 ref.

Descriptors: *Standards, *Fish, *Thermal pollution, Water quality, Temperature, Thermal power plants, Water pollution effects, Aquatic plants, Aquatic life, Cooling, Cooling water.
Identifiers: Thermal pollution effects, Temperature effects, *Waste heat.

A discussion on temperature standards is presented in this paper. The influence of temperature on chemical reactions taking place in waters can also determine the role of metabolism and activity of all aquatic organisms. Most of the attention has been focused on sports and commercial fish. The median tolerance value (TLm) of some species has been determined. The data on the other organisms than fish are not so detailed. Recommendation regarding temperature restrictions is presented. Growth of some species can take place at temperatures as high as 39C. Breeding seasons above 26.7C are likely to impair spawning and egg development. For most cold water species the requirement is about 11C. (Novotny-Vanderbilt)
W71-05130

POWER STATION SITE SELECTION IN ENGLAND AND WALES,
Central Electricity Generating Board, London (England).
F. R. Hunt.
International Atomic Energy Agency Symposium on Environmental Aspects of Nuclear Power Plants, New York, August 10-14, 1970. Preprint SM-146/35. 15 p, 4 fig.

Descriptors: *Thermal pollution, *Powerplants, *Sites, *Cooling water, Radioisotopes, Economics, Environment, Water pollution effects.
Identifiers: Gaseous wastes, Public opinion.

Over the 15 year period from 1961 to 1975, generating plant capacity in England and Wales will have been increased from 27000 MW to 67000 MW. Probably the most difficult problems currently facing power station planners in England and Wales are the visual impact on nearby urban areas of groups of cooling towers and the vapour plumes emitted from them which can be persistent at times of high atmospheric humidity and the creation of confidence on the part of licensing authority and public in near urban siting of nuclear stations. The main factors taken into account in the technical and economic evaluation of power station sites are fuel supply and delivery, cooling water, site area levels and foundation conditions, transmission lines, access for construction, ash disposal, aircraft obstruction and nuclear safety. The biological and chemical consequences of discharging warmed water have been extensively studied by the CEGB and ecological research carried out by them over a period of many years has confirmed that adverse thermal effects from power stations are virtually non-existent. (Upadhyaya-Vanderbilt)
W71-05136

THERMAL EFFECTS STUDIES FOR PALISADES NUCLEAR PLANT,
Consumers Power Co., Jackson, Mich.
John Z. Reynolds, and Kenneth A. Swarts.
Transactions of the American Nuclear Society Vol 13, No 1, p 233, July 1970.

Descriptors: *Thermal pollution, *Aquatic life, Benthos, Plankton, Periphyton, Fish, Lake Michigan, Eutrophication, Nuclear powerplants, Water pollution effects.
Identifiers: Sampling methods, Palisades nuclear plant.

A brief summary of surveys of Lake Michigan aquatic ecology near the Palisades Nuclear Plant is presented. Data from two years of preoperational surveys will be available for correlation with conditions observed after the plant has been operating. Extent of surveys and sample methods are described. The biological studies are concentrated on the benthos, plankton, periphyton and fish. (Jones-Vanderbilt)
W71-05137

NEW JERSEY V CITY OF NEW YORK (REMEDY AGAINST CITY FOR POLLUTION OF STATE WATERS AND BEACHES).
For primary bibliographic entry see Field 06E.
W71-05142

THE CHENA RIVER, THE STUDY OF A SUB-ARCTIC STREAM,
Federal Water Quality Administration, College, Alaska. Alaska Water Lab.
For primary bibliographic entry see Field 05B.
W71-05143

THE WEST FALMOUTH OIL SPILL-PERSISTENCE OF THE POLLUTION EIGHT MONTHS AFTER THE ACCIDENT,
Woods Hole Oceanographic Institution, Mass.
Blumer M. Sass, J. G. Souza, H. L. Sanders, and J. F. Grassle.
Available from NTIS as AD-713 947, $3.00 in paper copy, $0.95 in microfiche. Technical Report, Reference No 70-44, Sept 1970. 32 p, 18 fig, 3 tab, 7 ref. FWQA Grant 18050-EBN.
Identifiers: *Water pollution, *Oils, *Shellfish, Water pollution, *Marine biology, Bays, Toxicity, Massachusetts, Pelecypoda, *Buzzards Bay, *Water pollution damage, Sediments, Biodeterioration.

A spill of 650,000-700,000 liters of no 2 fuel oil has contaminated the coastal areas of Buzzards Bay, Mass. The present report summarizes the results of our continuing chemical and biological study which were available at the end of May 1970, more than eight months after the accident. The effects of environmental exposure on the composition of the oil are discussed; many analytical parameters are sufficiently stable to permit continued correlation of the oil remaining in sediments and organisms with the fuel oil involved in the spill. Oil from the spill is still present in the sediments, inshore and offshore and in the shellfish. A further spread of the pollution to more distant offshore regions has occurred during mid-winter; as a result, the pollution now covers a much larger area than immediately after the accident. The first stages of biological (presumably bacterial) degradation of the oil are now evident especially in the least polluted regions; however, it has depleted predominantly the straight and branched chain alkanes. The more toxic aromatic hydrocarbons are resistant; as a result, the toxicity of the oil has not been diminished. Where oil can be detected in the sediments there has been a kill of animals; in the most polluted areas the kill has been almost total. Shellfish that survived the accident have taken up the fuel oil. The 1970 crop of shellfish is as heavily polluted as was last year's crop. Oysters transplanted to unpolluted water for as long as 6 months retained the oil without chance in composition or concentration.
W71-05149

BACTERICIDAL EFFECTS OF ALGAE ON ENTERIC ORGANISMS,
Texas Univ., Austin. Center for Research in Water Resources.
Ernst M. Davis, and Earnest F. Gloyna.
Copy available from GPO Sup Doc as I67.13/4:18050 DOL 03/70, $1.25; microfiche from NTIS as PB-197 862, $0.95. Water Pollution Control Research Series 18050 DOL 03/70, March 1970. 132 p, 114 tab, 9 fig, 60 ref, 3 append. FWQA Program 18050 DOL.

Descriptors: *Algae, *Enteric bacteria, *Bactericides, Growth stages, Pathogenic bacteria, Cyanophyta, Chlorophyta, Scenedesmus, Algal toxins, Antibiotics (Pesticides), Data processing, Coliforms, Microorganisms, Hydrogen ion concentration, Waste water treatment, Water pollution effects.
Identifiers: *Mixed cultures, Dieoff rates, Aftergrowth.

Various enteric organisms were exposed to axenic cultures of green and blue-green algae to determine what effect the algae might have. Tests were extended to 90 days to determine whether aftergrowth was possible. Mixed cultures of both green and blue-green algae were exposed to both single species and mixed cultures of enteric bacteria, at varying stages of the algae growth periods. Results indicated that mixed cultures do have a pronounced bactericidal effect on enteric organisms, while for single algal species, the effect is less pronounced. Also, the bactericidal effects are more specific for pathogens, with virtually no aftergrowth of pathogens detected. (Lowry-Texas)
W71-05155

ACUTE TOXICITY OF LAS TO VARIOUS FISH SPECIES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
Thomas O. Thatcher, and Joseph F. Santner.
Proceedings Industrial Waste Conference, 21st, March 1966, Purdue University, Vol L, No 2, March 1966, Part II, p 996-1002. 1 fig, 4 tab, 9 ref.

Descriptors: *Toxicity, *Fishkill, Mortality, Water pollution effects, *Linear alkylate sulfonates, *Alkylbenzene sulfonates, *Detergents, Aquatic life.

Tests with LAS products were conducted during 1965 on five species of fish to determine the toxicity of this compound to aquatic life. A comparison of LAS values versus ABS values obtained in a previous test, indicated that LAS is 2-4 times as toxic to fish as is ABS. The data from this test demonstrates that sufficient difference in sensitivity to LAS exists among species of fish to warrant attention to this factor when assessing the potential hazard of LAS to aquatic populations. (Ellis-Texas)
W71-05172

CAUSES OF OYSTER SPAT MORTALITY, CONDITIONS OF OYSTER SETTING BEDS, AND RECOMMENDATIONS FOR OYSTER BED MANAGEMENT,
Bureau of Commercial Fisheries, Milford, Conn. Biological Lab.
Clyde L. MacKenzie, Jr.
National Shellfisheries Association, 1969 Proceedings, Vol 60, p 59-67, June 1970. 4 tab, 16 ref.

Descriptors: *Oysters, *Silts, Water pollution sources, Mortality, Fouling, *Predation, Commercial shellfish.
Identifiers: *Mechanical breakage, *Suffocation, *Starvation, Bryozoan poisoning, *Crassostrea virginica, American oyster, *Spot mortality, Starfish, Oyster drills.

The causes of oyster spat mortality conditions of oyster setting beds and recommendations for oyster bed management are described. As part of a study of mortalities of American oysters, Crassostrea virginica. The causes were identified of mortality of oyster spat between setting and age of 6 months and their relative importance was compared. The causes were complex and varied widely from bed to bed. They were a result of predation by various species, overgrowth by others, mechanical breakage during transplanting, suffocation by silt, early post-setting mortality (cause unknown), and deaths apparently from starvation and, in one location, from poisoning by a bryozoan. Two factors prevented much larger sets of oysters on commercial beds: (1) a small supply of clean oyster shells available for commercial oyster companies to plant and (2) layers of fouling organisms and silt that accumulate on shells planted for any length of time. (Wahtola-Washington)
W71-05202

A COMPARISON OF THE TOXICITY OF SOME COMMON INDUSTRIAL WASTE COMPONENTS TESTED INDIVIDUALLY AND COMBINED,
Kansas Univ., Lawrence; and Academy of Natural Sciences, Philadelphia, Pa.
John Cairns, Jr., and Arthur Scheier.
The Progressive Fish-Culturist, Vol 30, No 1, p 3-8, January 1968. 3 tab, 8 ref. US Public Health Service Grants RRG-3965 and EF00266.

Descriptors: *Waste disposal, *Industrial wastes, *Bioassay, Toxicity, Temperature, Water pollution effects, *Sunfish, *Water quality control, Chemical wastes, Mortality, Lethal limit, Chromium, Copper.
Identifiers: *Synergistic effects, *Acetic acid, *Acetaldehyde, *Acetone, *Naphthenic acids, Potassium cyanide, Zinc.

A comparison of the toxicity of some common industrial waste components were tested. These components were tested individually and combined. It is known that components of an effluent may interact so that their collective toxic effect on aquatic organisms can substantially differ from their individual toxicities. They were divided into three categories; additive, antagonistic, or synergistic. No dramatic interaction between the various components of the mixtures tested was evident. Support was found for the practice of segregating certain waste components for intensive treatment before disposal or compositing other wastes. (McConnell-Washington)
W71-05205

CHRONIC EFFECTS OF METHOXYLCHLOR ON BLUEGILLS AND AQUATIC INVERTEBRATES,
Bureau of Sport Fisheries and Wildlife, Columbia, Mo. Fish-Pesticide Research Lab.
Harry K. Kennedy, Lafayette L.Eller, and David F. Walsh.
Technical Papers of the Bureau of Sport Fisheries and Wildlife, No 53, March 1970. 18 p, 6 fig, 35 ref, 8 tab.

Descriptors: *Insecticides, Aquatic animals, Pathology, Persistence, Juvenile fishes, *Halogenated pesticides, Chlorinated hydrocarbon pesticides, *Sunfishes, Bioassay, *Water pollution effects, Mortality, Fish physiology, Fish reproduction, Pesticide residues, Diptera, DDT.
Identifiers: *Methoxychlor, Baetidae, Heptageniidae, Coenagrionidae, Physidae.

The chronic effects of methoxychlor on bluegills and various aquatic invertebrates is described. Bluegills (average weight 7 grams, average fork length 73 mm) were exposed to methoxychlor at concentrations of 0, 0.01, and 0.04 ppm in ponds for 13 weeks in late summer. Fish losses were small and not attributable to methoxychlor exposure. There were no significant differences in fish growth in the three pairs of ponds. Pathologic changes occurred in tissues and organs, primarily in livers and circulatory systems. Precipitated materials were observed in major blood vessels of gills and hearts 24 hours after treatment. This material coalesced, became multivacuolated, was conspicuous in most large blood vessels of every organ during the first week after treatment, persisted through day 28, and disappeared by day 56. Methoxychlor uptaken by the fish in 004-ppm-treated ponds was rapid, 21ppm by day 3; the insecticide was stored in whole body tissues through day 28 and metabolized or excreted by day 56. Significantly higher numbers of aquatic insects were sampled in treated ponds than in untreated, and insect numbers at high-treatment ponds were significantly higher than at low-treatment ponds. Chironomids were dominant and significantly increased after the 0.04-ppm treatment. Chironomids comprised 74 percent of samples from high-treatment ponds, but only 43 and 42 percent respectively from untreated and low-treatment ponds. Mayflies of the family Baetidae were less common. (Wahtola-Washington)
W71-05206

FISH AND CRAYFISH MORTALITIES DUE TO AN INTERNAL SEICHE IN GEORGIAN BAY, LAKE HURON,
Department of Lands and Forests, Maple (Ontario). Research Branch.
Alan R.Emery.
Journal of the Fisheries Research Board of Canada, Vol 27, p 1165-1168 1970. 9 ref, 1 tab, 1 fig.

Descriptors: *Thermal pollution, *Fish, *Great Lakes, Behavior, Sculpins, Crayfish, Trout, Perches, *Seiches, Fishkill, Mortality, Turbidity, Light penetration, Temperature.

Identifiers: *Lake Huron, Georgian Bay, *Orconectes.

Fish mortality due to an internal seiche is described. An internal seiche in Georgian Bay, Lake Huron, altered water temperatures and transparency in Little Dunks Bay (a small shallow bay). A sudden decrease in temperature was the probable cause of mortalities in sculpins (Cottus bairdi) and crayfish (Orconectes propinquus) as well as of marked changes in behavior of other fish species. Trout-perch (Percopsis omiscomaycus) appeared unaffected. (Wahtola-Washington)
W71-05208

FISHERY IMPLICATIONS ASSOCIATED WITH PROLONGED TEMPERATURE AND OXYGEN STRATIFICATIONS,
Arizona Cooperative Fishery Unit, Tucson.
Charles D. Ziebell.
Journal of the Arizona Academy of Science, Vol 5, No 4, p 252-262, October 1969. 5 fig, 13 ref.

Descriptors: *Temperature, *Oxygen, *Stratification, Solar radiation, Thermocline, Arizona, Fish behavior, Fish management, Hypolimnion, *Thermal stratification, Fisheries, Fish populations.
Identifiers: Overcrowding, Pena Blanca Lake.

Fishery implications associated with prolonged temperature and oxygen stratification for Pena Blanca Lake, Arizona, are described. The lake is stratified from March through November, which results in severe oxygen depletion in the hypolimnion. Possible overcrowding of mixed fish populations might cause inter-intraspecific competition for food and space. The unique limnology of Southern Arizona lakes cause unusual and challenging problems for fisheries management. (Katz-Washington)
W71-05209

AN ANAESTHETIC FOR COROPHIUM VOLUTATOR (PALLAS) AND MARINOGAMMARUS OBTUSATUS (DAHL), CRUSTACEA, AMPHIPODA,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
J. C. Gamble.
Experientia 25, p 539-540, 1969. 2 tab, 2 fig, 8 ref.

Descriptors: *Amphipoda, Temperature, Fish, *Crustaceans, Sea water, Aquatic animals, Fish physiology.
Identifiers: MS-222, *Anaesthetics, Corophium volutator, Marinogammarus obtusatus.

The experiments showed that MS-222 Sandoz is an effective anaesthetic for marine amphipods, Corophium volutator and Marinogammarus obtusatus. The optimal effective concentration is relatively high (1:2000) when compared with the doses (1:25,000 to 1:12,000) recommended for fishes. The fish, like amphipods, are anaesthetized easily, but take longer to recover after prolonged immersion in the anaesthetic. (Wahtola-Washington)
W71-05210

THE EFFECT OF CHINA CLAY ON THE BOTTOM FAUNA OF ST. AUSTELL AND MEVAGISSEY BAYS,
Ministry of Agriculture, Fisheries and Food, Burnham-on-Crouch (England). Fisheries Lab.
B. R. Howell, and R. G. J. Shelton.
Journal of the Marine Biological Association, Vol 50, p 593-607, 1970. 1 tab, 10 fig, 13 ref.

Descriptors: *Clay, *Deposition (Sediments), Fish, *Water pollution effects, *Benthic fauna, Industrial wastes, *Annelids, *Mollusks, Aquatic animals, Gastropods.
Identifiers: *Echinoidea, *Holothurioidea, China clay, *Ophiuroidea.

The deposition of china-clay waste has had a marked effect on the bottom fauna of St. Austell and Mevagissey Bays. Apart from an immediately inshore zone, where the rate of clay deposition is apparently severely limiting, the clay-affected zones support a rich community of deposit-feeding animals. Suspension-feeding forms which are common outside the clay deposits and in an adjoining bay, are largely absent from St. Austell and Mevagissey Bays. The behavior of pelagic fish in water polluted by clay wastes was investigated, but it was noted that fish would avoid the high turbidity. (Wahtola-Washington)
W71-05211

EVALUATING THE EFFECT OF INDUSTRIAL WASTES ON LAGOON BIOTA,
Missouri Univ., Columbia. Dept. of Civil Engineering.
Hardam S. Azad, and Darrell L. King.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965. Purdue University, Vol XLIX, No 3, p 410-422, July 1965. 7 fig, 1 tab, 21 ref.

Descriptors: *Biota, *Lagoons, *Industrial wastes, *Copper, *Chromium, Aquatic life, Respiration, Metabolism, Oxygen requirements, Photosynthesis, Hydrogen ion concentration, *Toxicity, Water pollution effects, Waste water treatment.
Identifiers: Potassium dichromate, Copper sulfate, Warburg.

A method was proposed which can be used to evaluate the shock load toxicity of a particular waste to the biota peculiar to a given lagoon before the waste is introduced to the lagoon. In order to do this the metabolic degradation of domestic wastes was evaluated by at least four different methods and for a wide variety of biotic communities. The impact of copper and chromium on lagoon metabolism was determined by comparing the oxygen demand of the samples subjected to the metals to that of a control containing just lagoon effluent. Copper, fed as copper sulfate, in concentrations greater than 0.20 mg/l was shown to seriously affect the performance of a waste stabilization lagoon while shock loads of hexavalent chromium, fed as potassium dichromate, were shown not to have any appreciable affect on lagoon performance at concentrations up to 40 mg/l. A significant depression of the pH and evolution of a gas appearing to be CO sq accompanies slug doses of Cu greater than 2.0 mg/l and Cr greater than 50 mg/l. (Ellis-Texas)
W71-05280

TOXICITY OF COPPER TO ACTIVATED SLUDGE,
Mead Corp., Chillicothe, Ohio.
For primary bibliographic entry see Field 05D.
W71-05284

DISPERSANT TOXICITY TEST PROCEDURES,
Ministry of Agriculture, Fisheries and Food, Burnham-on Crouch (England). Fisheries Lab.
R. G. J. Shelton.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C., American Petroleum Institute Publication No 4040, p 187-191. 7 ref.

Descriptors: *Oil wastes, Water pollution control, Cleaning, Chemicals, *Toxicity, *Aquatic life, *Bioassay, Water pollution effects.
Identifiers: Effectiveness evaluations, *Dispersants, Oil pollution, Coastal pollution.

Toxicity of chemicals to disperse oil is considered in relation to effects on fisheries and marine life. Toxic dispersants should not be used in large quantities in shallow coastal water, over shellfish beds, or fish nursery grounds, or in estuaries. Mechanical methods should be used in these areas and chemical methods used only on high-amenity beaches. Many commercially available dispersants and some experimental formulations have been tested. Oil and dispersants may affect fisheries marketability by adding displeasing flavours to fish and shellfish. (See also W70-10035) (Ensign-PAI)
W71-05331

STANDARD METHODS FOR DETERMINATION OF RELATIVE TOXICITY OF OIL DISPERSANTS AND MIXTURES OF DISPERSANTS AND VARIOUS OILS TO AQUATIC ORGANISMS,
Federal Water Pollution Control Administration, Washington, D.C. National Marine Water Quality Lab.
C. M. Tarzwell.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C., American Petroleum Institute Publication No 4040, p 179-186. 7 fig, 2 tab, 2 ref.

Descriptors: *Oil wastes, Water pollution control, Cleaning, Chemicals, *Toxicity, *Aquatic life, *Bioassay, ater pollution effects, Pollutant identification, Dispersion, Oily water.
Identifiers: Oil pollution, *Dispersants.

The relative toxicity of all chemical dispersants, both alone and in combination with oil, is determined prior to use for oil dispersion and the cleaning of beaches by the F. W. P. C. A. Data on the relative toxicity of these chemicals provide the grounds for the selection of these materials least toxic to aquatic life and for recommending or prohibiting their use. The F. W. P. C. A. feels that it is the responsibility of the manufacturer of these products to provide for their product alone and in oil mixture tolerance limit values based on standard short-term bioassays with designated test organisms. The F. W. P. C. A. recommends the standard bioassay procedure. This procedure is solely for the purpose of providing data to indicate relative toxicity of dispersants and dispersant mixtures. These tests do not indicate long-term toxicity of these chemicals or constitute an endorsement of any product by the F. W. P. C. A. (See also W70-10035) (Ensign-PAI)
W71-05332

5D. Waste Treatment Processes

LIQUID WASTE IN THE PULP AND PAPER INDUSTRY,
Stanley Associates Engineering, Ltd., Edmonton (Alberta).
D. R. Stanley.
Mand and His Environment, Vol 1, Proceedings of the First Banff Joint Conference on Pollution, The University of Calgary and the Engineering Institute of Canada, May 16-17, 1968, Banff, Alberta, Canada: New York, NY, Pergamon Press, Inc, p 43-51, 1970. 9 p, 3 fig, 1 tab.

Descriptors: *Water pollution sources, *Pulp and paper industry, *Pulp wastes, *Waste treatment, Methodology, Activated sludge, Trickling filters, Lagoons, Evaluation, Water quality, Chemical analysis, Biochemical oxygen demand, Model studies, Nitrogen, Phosphorous.

Water pollution problems due to liquid waste from the pulp and paper industry and methods of treatment to alleviate these problems are described. A specific problem of stream pollution due to waste from a bleached Kraft pulp mill in Alberta is presented and the approach used in solving the problem outlined. Several methods of treatment were considered including activated sludge, trickling filters, aerated lagoons and anaerobic lagoons. The activated sludge process provided the most reliable method of alleviating the problem, but would have been very expensive. The aerated lagoon type of treatment was considered to have the best potential as a technically feasible and economic solution to the problem. (See also W71-04901) (Woodard-USGS)

W71-04902

PETROCHEMICAL WASTE DISPOSAL,
Department of Health, Edmonton (Alberta).
For primary bibliographic entry see Field 05E.
W71-04903

FINDING PROFITS IN OIL-WELL WASTE WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
A. G. Collins.
Chemical Engineering, Vol 77, No 20, p 165-168, September 21, 1970. 4 p, 3 fig, 3 tab, 13 ref.

Descriptors: *Byproducts, *Brines, *Oil fields, *Brine disposal, Water reuse, Reclaimed water, Desalination, Waste water disposal.
Identifiers: Oil field brines.

Full exploitation of petroleum-associated brines for their chemicals will benefit the oil producer, the national economy, and pollution abatement. Sound conservation should favor the recovery of valuable elements from these brines, and with proper planning, the recovery processes should aid in ultimate disposal. A brine must contain a certain amount of recoverable chemicals before it can be considered economically valuable, and the further it must be pumped, the more chemicals it must contain. Several petroleum-associated brines contain enough sodium for the economical production of sodium chloride. This, coupled with the resultant pollution reduction and the presence of economic concentrations of other elements, should make chemical recovery from such brines still more attractive. Elements found in economic concentrations include magnesium, calcium, potassium , lithium, boron, bromine, and iodine, many of which are now recovered from seawater, salt lakes and subsurface saline waters. (Knapp-USGS)
W71-04907

AEROBIC STABILIZATION OF BEEF FEEDLOT WASTE,
Texas Tech Univ., Lubbock.
W. Grub, J. D. Martin, and L. L. Keeton.
Paper presented at the 1970 winter meeting American Society of Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-909. 6 p.

Descriptors: *Anaerobic digestion, *Biological treatment, Farm wastes, Moisture content, Aerobic conditions, Oxygen requirements, Stabilization, Nitrogen, Waste water treatment.
Identifiers: *Composting, *Carbon to nitrogen ratio (C/N), Housefly.

Solid waste that had accumulated on Southwestern beef cattle feedlots was aerobically stabilized under controlled conditions in enclosed digesters and in open air piles. Conditions for stabilization were determined and changes of physical, chemical and biological characteristics were established. The organic stabilization of beef feedlot waste by composting is a feasible process. Organic beef feedlot waste is compostable in specially designed digesters or in exposed open air piles, to a biologically stable organic product, free from noxious odors and inset infestation. Stabilized waste can be stored in a wet or dry state without danger of heating, attracting insects, or causing noxious odors. The time of stabilization depends on the type of original feed material, the condition of the waste at the start of the composting period, and the management of the composting process. Composting requires skilled management to obtain satisfactory results. (Christenbury-Iowa State)
W71-04911

GAS PRODUCTION FROM BEEF CATTLE WASTES,
Texas Tech Univ., Lubbock.
G. F. Meenaghan, D. M. Wells, R. C. Albin, and W. Grub.
Paper presented at the 1970 winter meeting American Society of Agricultural Engineers, Chicago, December 8-11, 1970, Paper No 70-907. 15 p, 9 fig.

Descriptors: *Anaerobic digestion, *Gases, Farm wastes, Chemical oxygen demand, Cattle, Carbon, Nitrogen, Hydrogen, Alkalinity, Methane, Biochemical oxygen demand, Waste treatment, Air pollution, Pollution abatement.
Identifiers: *Composting, *Gas production, Carbon to nitrogen ratio (C/N), Beef cattle, Carbonaceous material, Volatile acids.

A two-stage completely mixed isothermal digestion system having a capacity of 30 gallons/stage was fed wastes from a beef cattle controlled environment chamber. Gas production was monitored and analyzed by a wet test meter and a gas chromatograph, respectively. Physical and bio-chemical tests were also performed. This study indicates that a completely mixed, two stage anaerobic digestion system is technically feasible and can be used for obtaining nominal treatment of beef cattle wastes. Even with optimal conditions per stage such a system will not be sufficient for complete treatment. (Christenbury-Iowa State)
W71-04912

EFFECTS OF MANURE DEPTH ON RUNOFF FROM SOUTHWESTERN CATTLE FEEDLOTS,
Texas Tech Univ., Lubbock.
For primary bibliographic entry see Field 05B.
W71-04913

IN VITRO DIGESTIBILITY OF CHEMICALLY-TREATED FECES,
Department of Agriculture, Beltsville, Md. Animal Science Research Div.
L. W. Smith, H. K. Goering, and C. H. Gordon.
Journal of Animal Science, Vol 31, No 6, p 1205-1209, December 1970. 4 tab, 16 ref.

Descriptors: *Digestion, *Chemical degradation, Farm wastes, Ruminants, Fermentation, Cellulose, Costs, Alkalis, Waste treatment.
Identifiers: *Chemically-treated feces, Cell wall, Microbial responses, Oxidants.

Chemical treatment is a means for enhancing the digestibility of the indigestible plant cell wall residues in ruminant feces. Enhanced digestibility was ascertained with detergent solubility methods and in vitro rumen fermentation were obtained through dried chemical degradation of meicellulose, cellulose, and lignin and also through increasing the accessibility of the remaining cell wall for ruminal microbial fermentation. Chemical treatment of indigestible alfalfa or sudax fecal cell walls resulted in greater than 90% digestion (chemical degradation and microbial digestion). This experiment was designed to point out some of the conditions required for maximum chemical hydrolysis and maximum cell wall utilization. Whether or not these conditions can be approximated in feeding trials remains to be demonstrated. (Christenbury-Iowa State)
W71-04915

CATTLE WASTES - POLLUTION AND POTENTIAL TREATMENT,
Kansas Univ., Lawrence. Dept. of Civil Engineering; and Kansas Univ., Lawrence. Environmental Health Engineering Lab.
Raymond C. Loehr, and Robert W. Agnew.
Journal of the Sanitary Engineering Division, ASCE, Vol 93, No SA4, p 55-72, August 1967. 2 fig, 9 tab, 29 ref.

Descriptors: *Farm wastes, *Cattle, *Water pollution sources, Rivers, Fishkill, Moisture content, Biochemical oxygen demand, Chemical oxygen demand, Nitrogen, Anaerobic digestion, Oxygen demand, Lagoons, Hydrogen ion concentration, Effluent, Aeration, Sludge, Runoff, Waste water treatment.
Identifiers: *Feedlots, Cattle production, Pollution potential, Loading rages, Profit potential, Waste characteristics, Total solids, Population equivalent, Digesters, Anaerobic lagoons.

The problem of cattle feedlot waste treatment and the results illustrated in this paper can be summarized as follows: The diversified family farm is giving way to specialized large-scale factory-type operations such as beef cattle feedlots. Farm enterprises which formerly were dispersed over large remote land areas are now concentrated in small areas, frequently near communities, and intensify problems of waste disposal. Runoff from feedlots is a significant problem and treatment systems must be able to handle slug loads and flows without causing stream pollution. The profit potential and the amount of concern of the feedlot operator for adequate waste treatment will dictate the type of system that will be practical and economical. The quantity and the undesirable qualities of the wastes from a beef feedlot are such that a combination treatment system may be the most successful. A combined anaerobic-aerobic lagoon system has significant potential. The effluent from an anaerobic lagoon is potent and must receive further treatment before discharge to a receiving stream. Even after adequate removal of organics, the effluent may pose a problem because of its color and its fertilization capacity. (White-Iowa State)
W71-04916

THE COLLECTION OF MANURE FROM HOUSED LIVESTOCK,
West of Scotland Agricultural Coll., Glasgow (Scotland). Dept. of Farm Buildings.
R. J. Forsyth.
Journal and Proceedings of the Institution of Agricultural Engineers, Vol 21, p 129-133, 1965.

Descriptors: *Farm wastes, *Cattle, Water pollution control, Sludge, Storage capacity, Storage tanks, Waste dilution, Construction materials, Costs, Slurries, Sluice gates, Electric power costs, Rotors, Waste water treatment.
Identifiers: *Dairy cattle, *Oxidation ditch, Slatted floors.

The paper describes collection and handling methods for dairy manure in Scotland. Parlor systems are scarce because of their large bedding requirement. Slatted floors in conjunction with free housing systems has proven highly satisfactory. Different slat types are discussed and evaluated. Under slat tanks or channels are described as well as criteria for dilution, storage capacity, and sluice gates. The possibility of using the Pasveer oxidation ditch is introduced as a result of stringent pollution regulation. Design and costs for the oxidation ditch are presented. A discussion follows the paper. (White-Iowa State)
W71-04917

AEROBIC PURIFICATION OF FARM WASTE,
Rijkszuivel Agrarische Afvalwater Dienst, Arnhem (Netherlands).
H. M. J. Scheltinga.
Journal Proceedings of the Institution of Sewage Purification, p 585-588, 1966. 1 fig, 4 tab, 11 ref.

Descriptors: *Farm wastes, *Hogs, *Biological treatment, Anaerobic digestion, Activated sludge, Rotors, Nitrogen, Biochemical oxygen demand, Chemical oxygen demand, Foaming, Nitrification, Costs, Effluent, Laboratory tests, Ammonia, Waste water treatment.
Identifiers: *Oxidation ditch, Loading rates, Retention time.

Model tests, laboratory investigations, and finally a full scale field experiment with oxidation ditches were carried out in Holland, where an effective and economical waste treatment system is being sought. A 50 per cent BOD reduction was obtained using anaerobic decomposition in the laboratory. Initial and final characteristics of the pig waste are given before and after treatment in the oxidation ditch.

Foaming was excessive from the start. Nitrification played an important part in eliminating the ammonia. Total and expected operational costs are given. (White-Iowa State)
W71-04920

THE BACTERIAL POPULATION OF AN INDOOR POULTRY LAGOON,
Louisiana State Univ., Baton Rouge. Agricultural Experiment Station; and Louisiana State Univ., Baton Rouge. Dept. of Microbiology; and Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering; and Louisiana State Univ., Baton Rouge. Dept. of Poultry Science.
Leon J. Cabes, Jr., Arthur R. Colmer, Harold T. Barr, and Benjamin A. Tower.
Poultry Science, Vol 48, No 1, p 54-63, 1969. 2 fig, 3 tab, 17 ref.

Descriptors: *Farm wastes, *Poultry, *Oxidation lagoon, Microorganisms, E. coli, Aeration, Sampling, Coliforms, Bacteria, Pathogenic bacteria, Temperature, Hydrogen ion concentration, Biochemical oxygen demand, Aerobic bacteria, Waste water treatment.
Identifiers: *Laying house, *Bacterial counts, Enterococci, Suspended solids, Manometric studies.

The study was concerned, first, with the enumeration, isolation, and classification of the predominant bacterial flora of an indoor poultry waste stabilization lagoon, and secondly, with an evaluation of this flora to determine the organisms most active in the degradation process. The lagoon consisted of a pit 3 feet 6 inches deep x 13 feet wide x 88 feet long inside a laying house which measured 14 feet x 100 feet. The standard plate counts of aerobic organisms present in the waste water of the lagoon are presented in tabular form. Total solids, pH and BOD reduction data are also presented. The lagoon was aerated with 200 feet of perforated pipe which feed 4 cfm of air at 15 psi. It is felt that additional modifications might be instituted. (White-Iowa State)
W71-04921

NUTRITIVE VALUE OF OXIDATION-DITCH RESIDUE,
Illinois Univ., Urbana.
B. G. Harmon, A. H. Jensen, and D. H. Baker.
Journal of Animal Science, Vol 29, No 1, p 136, July 1969.

Descriptors: *Nutrients, Farm waste, Feeds, Value, Aerobic treatment, Diets, Amino acids, Energy, Waste water treatment.
Identifiers: *Excreta, *Swine, Feed value, Oxidation-ditch, Rats.

Swine excreta suspended in water and adjutated to promote aerobic digestion was studied as a source of nutrients. In four growth trials 132 weanling rats were used to study the nutritive value of amino acids and energy contained in the oxidation-ditch residue (ODR). The digestible energy decreased linearly as ODR was added to the diet. (Christenbury-Iowa State)
W71-04922

LOSSES OF ENERGY AND NITROGEN ON DRYING POULTRY EXCRETA,
Queen's Univ., Belfast (Northern Ireland). Dept. of Agricultural Chemistry.
D. W. F. Shannon, and W. O. Brown.
Poultry Science, Vol 48, p 41-43, 1969. 1 tab, 3 ref.

Descriptors: *Farm wastes, *Poultry, Energy, Nitrogen, Drying, Freeze drying, Vacuum drying, Forced drying, Temperature, Waste treatment.
Identifiers: Kjeldahl nitrogen, Metabolizable energy, Dry matter.

Losses of energy and nitrogen were determined from samples of fresh excreta differing in dry matter and nitrogen content. The samples were dried under the following conditions - feeze drying, vacuum drying at 40C and drying in forced-air ovens at 60C, 100C, and 120C. Nitrogen of the undried and dried excreta was determined by the conventional Kjeldahl method. The mean results of ten energy determinations (%) on fresh excreta samples A and B were 804, 753, 2.51 respectively. The energy losses are in agreement with other authors. From the results of the experiment, the drying temperature should be chosen depending on whether the energy or nitrogen content is more important. In the determination of metabolizable energy, then the method giving lower energy errors would be used. (White-Iowa State)
W71-04925

PHYSICAL AND BIOLOGICAL EVALUATION OF FIVE LITTER MATERIALS,
Purdue Univ., Lafayette, Ind. Dept. of Animal Sciences.
Paul L. Ruszler, and James R. Carson.
Poultry Science, Vol 47, p 1712, 1969.

Descriptors: *Farm waste, *Poultry, *Absorption, Moisture, Particle size, Laboratory tests, Waste water treatment, Waste treatment, Water pollution effects.
Identifiers: *Litter materials, Field conditions, Peanut shells, Pine bark, Ground cobs, Wood shavings, Cane pomace.

The usefulness of peanut shells, pine bark, ground cobs, wood shavings and cane pomace as litter materials in rooster production was evaluated under laboratory and field conditions on the basis of their physical properties and effects on the birds during a 14-week growing period. When the amount and rate of moisture exchange was compared, it was found that all five materials differed significantly. When ranked by grams of moisture absorbed per gram of dry weight, cane was highest, followed by shavings, cobs, shell, and bark. The materials with the smaller particle sizes absorbed less total moisture in both growing house and laboratory tests. The same materials rated low in breast blister incidence, but without statistical significance. (White-Iowa State)
W71-04926

THE SEARCH FOR NEW POULTRY LITTER MATERIAL - AN EXAMPLE OF COOPERATION BETWEEN EXTENSION, RESEARCH AND INDUSTRY,
Georgia Univ., Athens. Dept. of Poultry Science.
Milton Y. Dendy, M. J. Reed, and M. G. McCartney.
Poultry Science, Vol 45, p 1666, 1968.

Descriptors: *Farm wastes, *Poultry, Physical properties, Performance, Agricultural engineering, Waste treatment, Pollutants.
Identifiers: *Litter materials, Pine bark, Pine bark and chips, Pine stump chips, Rice hulls, Poultry industry, Extension Poultrymen.

In the fall of 1966 a litter shortage was brought to the attention of the Extension Poultrymen during an industry meeting. The Extension Poultrymen took the problem to the research people in the Department of Poultry Science and the Department of Agricultural Engineering at the University of Georgia, and a project was started to test (1) the physical properties and performance characteristics of materials usable as litter in poultry houses, and (2) bird performance on several materials available in Georgia were tested, including pine shavings and pine sawdust, the two materials most commonly used. Results obtained indicate that some of the materials such as pine bark, pine bark and chips, pine stump chips and rice hulls are about as suitable for poultry litter as pine shavings or pine sawdust. (White-Iowa State)
W71-04928

THE DIGESTION OF POULTRY FECES UNDER CAGES,
Auburn Univ., Ala. Dept. of Poultry Science.
J. R. Howes.
Poultry Science, Vol 47, p 1682, 1968.

Descriptors: *Farm wastes, *Poultry, *Aerobic conditions, Odor, Aerobic bacteria, Fertilizer, Nitrogen, Stabilization, *Waste treatment.
Identifiers: *Absorbent substrate, *Cage operation, *Inoculation, Control plots.

A series of small experiments were carried out under cages with and without concrete floors, using various absorbent substrates for poultry feces. After an initial buildup period, the feces and substrate was inoculated with aerobic bacteria and aerobic conditions maintained by disturbing the surface cake at intervals. These experiments led to a field trial without any absorbent substrate at a large cage operation in south Florida, which has now been in operation for 18 months. Odors and flies have been largely eliminated except in control plots and spraying for fly control greatly reduced. The bulk of the fecal pile was less than half the volume of the control plots due to stabilization of nitrogen and water losses. Feathers were digested if they were incorporated into the fecal pile and the resulting material was a homogenous, odorless fertilizer which has been used in urban gardens and on golf greens. (White-Iowa State)
W71-04929

CATALYTIC OXIDATION OF ORGANIC COMPOUNDS IN WASTE WATER,
Southern Illinois Univ., Carbondale. Dept. of Chemistry; and Illinois Univ., Urbana. Water resources center.
Gerard V. Smith, F. Patil, Yuri Pavlov, and Juh V. Chen.
Available from NTIS as PB-197 733, $3.00 in paper copy, $0.95 in microfiche. Illinois Water Resources Center, Urbana, Research Report No 36, January 1971. 18 p, 7 tab, 2 fig, 9 ref. OWRR Project B-022-Ill (1).

Descriptors: *Tertiary treatment, *Waste water treatment, Municipal wastes, *Organic wastes, *Separation techniques, *Oxidation.
Identifiers: *Catalysis, Ultransonic destruction, *Catalytic oxidation, Catalytic destruction, *Municipal waste water.

Through studies of the effect of ultrasound on catalysts it has been found that certain water pollutants can be oxidized or modified. This synergetic effect between ultrasound and certain heterogeneous catalysts, sonocatalysis, is demonstrated qualitatively for a number of organic compounds (anilines, stilbestrol, orthochloronitrobenzene and phenol) and quantitatively for the oxidation of iodide ion. The technique shows promise as a tertiary treatment of municipal waste water. (Smith-Illinois)
W71-04936

SPECIALIZED HALOGEN GENERATOR PATENT APPLICATION,
National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center.
R. A. Bruce.
Available from NTIS as N70-35681, $3.00 in paper copy, $0.95 in microfiche. NASA Case XLA 8913, Serial No 865109, Oct 9, 1969. 11 p.
Identifiers: *Chlorination, *Gas generators, *Potable water, *Spacecraft environments, Closed ecological systems, Patent applications.

An apparatus is described for generating controlled quantities of a halogen gas as needed in a water purifying system. The apparatus is designed to eliminate bacteria from contaminated water and render it safe for human consumption. The chlorine generator is for use in a closed integrated life support system on board manned spacecraft for sterilizing potable water and maintaining stowed water in a sterile condition.
W71-04941

RETENTION TIME AND CIRCULATION STUDY IN A SEWAGE STABILIZATION LAGOON,
Geological Survey, Raleigh, N.C.
William G. Stamper.
For sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D301-D304, 1970. 4 p, 3 fig, 1 ref.

Descriptors: *Tracers, *Dye releases, *Sewage lagoons, *Sewage treatment, *Water circulation, North Carolina, Oxidation lagoons, Fluorescence.
Identifiers: *Benson (NC).

Two sewage stabilization lagoons used by the town of Benson, N.C., were suspected of having an average retention time much less than the designed 30 days. A short circuit in the flow pattern was suspected to be the cause. During the summer of 1969, fluorescent dye was injected into the two lagoons in studies designed to determine the average retention time and the flow pattern of each sewage lagoon. The retention times were found to be considerably less than 30 days, and a definite short circuit in the flow pattern was shown to exist. (Knapp-USGS)
W71-04978

PLATING WASTE-CONTINUOUS OR BATCH TREATMENT,
General Motors Corp., Detroit, Mich. Plant Engineering Section.
J. S. Delos.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 138-144, July 1968. 5 fig, 1 tab.

Descriptors: *Chromium, *Waste water treatment, Costs, Acids, Hydrogen ion concentration, Neutralization, Industrial wastes.
Identifiers: *Cyanide, *Batch treatment, *Plating wastes.

Genral Motors Corporation conducted tests at their Syracuse Plant to determine whether continuous or batch treatment was the better mode of treating plating waste. The batch system is being used since it offers a greater amount of safety although the initial capital cost is higher than continuous flow. Continuous flow requires constant attendance along with the need to provide an excess of chemical treatment for cyanide and chromium. With the batch system, no untreated wastes leave the plant because of a malfunction of automatic equipment. (Ellis-Texas)
W71-04998

ACID MINE DRAINAGE RESEARCH AT THE OHIO STATE UNIVERSITY,
Ohio State Univ., Columbus. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 05G.
W71-04999

FIELD STUDIES ON AN ANAEROBIC LAGOON TREATING SLAUGHTERHOUSE WASTE,
Public Health Service, Shiprock, N. Mex.
Keith E. Enders, Mark J. Hammer, and Clinton L. Weber.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 126-137, July 1968. 5 fig, 6 tab.

Descriptors: *Anaerobic conditions, Anaerobic bacteria, Lagoons, Temperature, Hydrogen ion concentration, Effluents, Dissolved oxygen, Chemical oxygen demand, Biochemical oxygen demand, Industrial wastes, *Waste water treatment, *Oxidation lagoons.
Identifiers: *Slaughterhouse wastes.

Studies were performed on anaerobic lagoon waste treatment units located in the rural countryside of Northeast Nebraska to determine their effectiveness in treating slaughterhouse wastes. If designed in accordance with accepted methods, anaerobic lagoons can be used as a first stage treatment and also have the capacity to handle shock loads and intermittent loadings without significant loss of treatment efficiency. The BOD removal during these studies was greater than 980% and solids buildup appeared to be extremely slow. The primary bacterial activity was the conversion of volatile solids to gaseous end products. (Ellis-Texas)
W71-05000

ELIMINATION OF NITRATE FROM AN INDUSTRIAL WASTE,
Badische Anilin- und Soda-Fabrik, A.G., Ludwigshafen am Rhein (West Germany).
Walter Haltrich.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 203-210, July 1968. 5 fig, 8 ref.

Descriptors: *Denitrification, *Acitvated sludge, Nitrogen, Nitrite, Nitrates, Biochemical oxygen demand, *Aeration, Sedimentation, Effluent, Organic compounds, Aromatic compounds, Alcohols, Indurstrial wastes, *Waste water treatment, Aerobic conditions, Anaerobic conditions, *Organic wastes, Biological treatment.
Identifiers: Aliphatic compounds, Aldehydes.

Studies were conducted to what effect denitrification can be accomplished in activated sludge. Continuous-flow experiments as well as batch studies were conducted under aerobic and anaerobic conditions. As a result of these experiments it was found that efficient denitrification of an industrial waste can be achieved with the activated sludge process if the nitrate is split in an unaerated stage preceding aeration. If the waste water contains organic impurities (hydrogen donors), denitrification proceeds so rapidly that the dentention time in a plant with denitrification is no greater than a conventional activated sludge plant. (Ellis-Texas)
W71-05001

NEW DEVELOPMENTS IN THE TREATMENT OF METAL FINISHING WASTES BY ION EXCHANGE OF RINSE WATERS,
Bavarian Bureau of Water Supply and Pollution Control, Munich (West German).
Friedick K. Von Ammon.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 788-799, July 1968. 6 fig, 4 tab.

Descriptors: *Recirculated water, *Ion exchange, Cation exchange, Anion exchange, Water reuse, Industrial water, Hydrogen ion concentration, Detergents, Costs, Metals, *Waste water treatment.
Identifiers: Metal refinishing, Germany, Rinse water, Cyanide, *Metal finishing wastes.

The advantages and problems of ion exchange and recirculation are discussed from the experiences of three new plants in Germany. The type and situation of the plants, collection of rinse waters, the design and operation of the ion exchange process, the properties of the circulated water, the waste water treatment, the properties of final effluent, and economic considerations are discussed. Recirculation was found to be more economical unless costs for water supply are extremely low or no waste treatment is required. Recirculation results in the reduction in waste quantity which gives obvious advantages for reduced waste treatment and a lower pollution load on receiving waters. (Ellis-Texas)
W71-05002

ACTIVATED SLUDGE TREATMENT OF SOME ORGANIC WASTES,
Water Pollution Research Lab., Stevenage (England).
A. B. Wheatland.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 983-1008, July 1968. 14 fig, 8 tab, 2 ref.

Descriptors: *Activated sludge, *Organic wastes, Domestic wastes, Farm wastes, Industrial wastes, Sewage, Biochemical oxygen demand, Aeration, Chemical oxygen demand, *Waste water treatment.
Identifiers: *Contact stabilization, Sludge volume index, Suspended solids.

Four investigations of the suitability of activated sludge or its modifications, in treating waste waters from : (1) the production and dyeing of a synthetic fiber; (2) a mixed effluent from the dyeing of Terylene, Nylon, and polyacrylic fibers; (3) the production of a synthetic rubber; and (4) a partial treatment of dairy effluent. The process can be successfully used for the treatment of waste waters from a variety of industries if suitable conditions are provided for the microorganisms to become acclimatized to the wastes. It may be necessary to dilute the waste water if it contains significant concentrations of potentially toxic or inhibitory organic substances and domestic sewage should be considered as a diluent if the waste water under consideration lacks certain inorganic nutrients or trace elements necessary to enhance treatment. (Ellis-Texas)
W71-05003

USE OF POLYELECTROLYTE COAGULANTS TO ENHANCE SETTLING CHARACTERISTICS OF ACTIVATED SLUDGE,
Weston (Roy F.), Inc., Newtown Square, Pa.
J. F. H. Walker, and J. H. Dougherty.
Proccedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 715-723, July 1968. 6 fig, 1 tab.

Descriptors: *Coagulation, *Activated sludge, Sedimentation, Flocculation, Biochemical oxygen demand, Flotation, *Waste water treatment, Electrolytes, *Settling velocity.
Identifiers: *Polyelectrolytes, Coagulants, Utilization rates, Anionic, Cationic, Nonionic, Agglomeration.

Studies were conducted on 3 anionic, 6 cationic and 3 nonionic polyelectrolyte coagulants to determine their affect as coagulant aids in settling and flocculation of activated sludge. The BOD reaction rates were significantly suppressed with certain polyelectrolyte materials studied and oxygen utilization rates were not significantly affected. No one type of polyelectrolyte was found to be universally effective in increasing the agglomeration and settling rate of activated sludge but, on occasion, sufficient gas entrapment might occur to result in the flotation of sludge flocs. It was determined that polyelectrolyte coagulant aids could be useful in the solution of the settling problems encountered in many waste water treatment plants. (Ellis-Texas)
W71-05004

INDUSTRIAL WASTE TREATMENT AT TRANS WORLD AIRLINES OVERHAUL BASE,
Burns and McDonnell Engineering Co., Kansas City, Mo.
George C. Higgins.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 194-202, July 1968. 1 fig, 2 tab, 4 ref.

Descriptors: *Industrial wastes, Oil, Instrumentation, Trickling filters, Filtration, Hydrogen ion concentration, Biochemical oxygen demand, Chemical oxygen demand, *Waste water treatment, Aircraft, *Oil wastes.
Identifiers: *Metal finishing wastes, Vacuum filtration.

New waste treatment facilities under construction will be adequate in capacity to handle the existing fleet of aircraft at TWA until the jumbo jet and supersonic planes enter the fleet. There are four distinct waste streams requiring treatment from the industrial complex which comprises an overhaul facility: (1) alkaline-cyanide; (2) acid-chrome; (3) industrial-petroleum; and (4) sanitary. Two basic systems have been set up to treat petroleum wastes

and metal finishing wastes. The instrumentation necessary to control these systems, the secondary treatment facility, the tertiary treatment portion, and the sludge handling method are also discussed in this article. (Ellis-Texas)
W71-05005

REGENERATION OF HYDROCHLORIC ACID FROM WASTE PICKLE LIQUOR,
Haveg Industries, Inc., Wilmington, Del.
S. S. Spater.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 366-374, July 1968. 9 fig.

Descriptors: *Chemical wastes, Industrial wastes, Corrosion, Adsorption, Turbulence, Phenols, *Waste water treatment.
Identifiers: *Pickle liquor, *Hydrochloric acid, Sulfuric Acid, *Regeneration, Electrostatic precipitator, Turbulator.

The removal of oxide films, or scale, from metal by placing it in an acid bath is known as pickling. Formerly, spent pickle liquor was neutralized and discharged since no process for regeneration of sulfuric acid had been discovered. Increasingly stringent pollution control laws led to investigations into the applicability of hydrochloric acid in place of sulfuric acid in the pickling process. The Haveg Turbulator process is one which can regenerate hydrochloric acid from spent pickle liquor with great efficiency. This process reverses the process of producing FeCl2 from iron oxide and hydrochloric acid with: (1) a high turbulence reactor, (2) an air preheater, (3) and electrostatic precipitator, (4) an adiabatic adsorption column. This process has advantages of: (1) high reaction rates resulting in decreased space requirements, (2) high operating flexibility with very short start-up and shut-down times, (3) low maintenance requirements, (4) actual in-plant operation at present. This system presents an economical alternative to sulfuric acid pickle liquor with its versability and regeneration capability. (Lowery-Texas)
W71-05006

TREATMENT OF NON-FERROUS METAL PROCESS WASTE AT KYNOCH WORKS, BIRMINGHAM, ENGLAND,
Imperial Metal Industries (Kynoch) Ltd., Birmingham (England).
E. H. F. Stone.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 848-865, July 1968. 9 fig, 5 tab, 1 ref.

Descriptors: *Industrial wastes, Neutralization, Hydrogen ion concentration, Emulsion, Sedimentation, Sludge disposal, Filtration, *Waste water treatment, Metals.
Identifiers: Non-ferrous metal process waste, Hexavalent chromium, Polyvinyl chloride, Suspended solids, *Metal wastes.

A redrainage and effluent treatment system has been built at the Kynoch Works of Imperial Metal Industries as a result of The Rivers (Prevention of Pollution) Act of 1951. Chemical problems affecting plant design were: (1) Neutralization and pH control; (2) hexavalent chromium concentration determination and treatment; (3) oil separation; (4) sedimentation and (5) sludge disposal. It was decided to allow the effluent to flow by gravity to a central treatment plant which meant redrainage of the entire factory site with polyvinyl chloride. Neutralization was accomplished by a continuous flow system comprising a series of tanks, each pair of which form a pH control stage. After neutralization the effluent is pumped to settling tanks where suspended solids and oil separation is conducted. The sludge is dewatered by vacuum filtration and the filtrate recycled to the wet well at the end of the neutralizing tanks. The instrumentation required for pH control, flow control of lime slurries, a pH recorder, flow-metering and sampling and control of main effluent pumps. (Ellis-Texas)
W71-05007

EFFECT OF CENTRATE FROM SOLID BOWL CENTRIFIUGE ON ACTIVATED SLUDGE PROCESS,
Metropolitan Sanitary District of Greater Chicago, Ill.
Thomas J. Kennedy, and A. J. Kaplovsky.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 145-164, July 1968. 11 fig, 8 tab, 25 ref. FWPCA Demonstration Grant WPD 77-01.

Descriptors: *Centrifugation, *Metabolism, Phosphate, Nitrogen, Microorganisms, Coliforms, *Activated sludge, Chemical oxygen demand, Biochemical oxygen demand, *Waste water treatment.
Identifiers: *Sludge Volume Index, *Centrate, Volatile suspended solids, Filamentous organisms.

Two identical activated sludge pilot plants were constructed to study the effects of the recirculation of centrate from a sludge solids bowl-type centrifuge. One of the reactors received centrate, and the other was used as a control. Laboratory analysis determined that the centrate contained mainly generated fines consisting of dissolved zoogloeal masses and fragments of filamentous forms. It was also determined that primary treatment could remove the bulk of centrate solids from centrifugation installations operating at solids recoveries of at least 70%. Centrate solids, obtained from centrifugation of total waste solids output with 80% solids recovery, continuously returned to a conventional activated sludge plant produced no detrimental effects upon effluent quality or the activated sludge process itself. Consistently higher sludge volume indices were noted in the re-cycled reactor, however, but a certain limit was reached beyond which the SVI deteriorated no further. One possible explanation of this phenomena is the breakup of filamentous organisms in the centrifugation process, and their subsequent accelerated cell division and growth when placed in a biologically active reactor. (Lowry-Texas)
W71-05008

EGG LAYING HOUSE WASTES,
Steeg (Henry B.) and Associates, Inc., Indianapolis, Ind.
Charles F. Niles, Jr.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 334-341, July 1968. 1 fig, 2 tab.

Descriptors: *Farm wastes, *Confinement pens, *Forced drying, Incineration, Manure, Fertilizer, Farm lagoons, *Waste water treatment, *Waste disposal.
Identifiers: Carcasses, Laying houses.

The Berry Best Egg Company utilizes 205,000 hens in producing 11,000 dozen eggs per day. These hens produce 41,000 lbs (wet weight) of droppings and an average of 50 dead hens per day. Diposal of the wastes was attempted in a pond system, where vigorous anaerobic digestion ensued along with danger of flooding of recreational areas. Alternative methods of treatment which were investigated were: (1) solids drying; (2) controlled anaerobic digestion; (3) land disposal; (4) incineration; (5) aerobic treatment; (6) sedimentation; (7) centrifugation; and (8) hydroponic agriculture. Solids drying was selected as the optimum system for this operation. New solids collecting devices were installed to minimize the water used for collection. 40,000 gpd of water had previously been used for cleaning and solids carriage. A Badger Barn Cleaner conveyor was used to carry the wastes from a central dump station to the dryers. The solids were fed in automatically while hen carcasses were placed on by hand to equalize the load. The solids were ground in a hammermill, dryed, and either bagged for sale as fertilizer, or collected for land disposal. At the present time, the system is still in the initial shakedown period and no definite results on loadings and efficiencies have been obtained. However, it is thought that this process holds much promise for this type of operation in the future. (Lowry-Texas)
W71-05009

THE TREATMENT OF WASTE WATER FROM THE CHRYSLER OUTBOARD ENGINE PLANT LOCATED IN HARTFORD WISCONSIN-A CLOSED SYSTEM,
Chrysler Corp., Detroit, Mich.
A. R. Balden.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Engineering Bulletin of Purdue University, Vol LII, No 3, p 397-402, July 1968. 6 fig.

Descriptors: *Separation techniques, Oil, *Emulsions, Bentonite, Flotation, Coagulation, Corrosion, Hydrogen ion concentration, Industrial wastes, *Waste water treatment, Wisconsin, *Oil wastes, Electrolytes.
Identifiers: *Polyelectrolyte, Suspended solids, Outboard motors, Rubicon River, Hartford (Wisc).

All outboard motors produced by the Chrysler Corporation Outboard Engine plant must be tested in a tank to determine whether or not they are properly assembled and ready for sale. These engines run on an oil-gas mixture, and an oil film builds up on the surface of the test tank. To keep this oil from permanently marking the engines an emulsifier is added. All other wastes streams could be economically handled except this one. Suspended solids content of the test tank could range as high as 1000 mg/l. Because of the scarcity of cheap water it was decided that this water should be recycled through the cooling towers and finally back to the test tank. The only treatment method which could reduce the oil content, and at the same time not remove the corrosion inhibitor which must be present to safeguard the plant was an anionic polymer in combination with a bentonite clay. The chemicals are added to influent which is mixed with air under pressure. The waste stream is released to a flotation tank, and as the floated floc comes to the surface it is skimmed off as scum. The clarified process water is then recycled through the plant. The quality of the water is not sufficiently high to allow direct discharge to a receiving stream, but in this case recycle is both desirable and economical. (Lowry-Texas)
W71-05010

TREATMENT AND DISPOSAL OF EFFLUENT FROM A 450 TON PER DAY KRAFT PULP AND PAPER MILL INTO CLASSIFIED INLAND WATERS,
New Zealand Forest Products Ltd., Tokoroa.
J. L. Vickerman.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 968-982. 8 fig, 1 tab.

Descriptors: *Water purification, *Pulp and paper industry, Pulp wastes, Wood wastes, Effluents, Industrial wastes, Sedimentation, Seepage, Soil properties, Soil texture, Costs, *Waste water treatment.
Identifiers: Waikato River, New Zealand, Clarifier.

Although the Kinleith Mill suffers from the disadvantage of discharging into New Zealand's longest and most utilized inland waterway, it is endowed with two natural advantages: (1) a considerable potential for purification inherent in the 360 ft. fall of the effluent stream to the Waikato River; and (2) a gopography and soil suited to a good volume of seepage disposal. To treat this effluent they have constructed two sewer systems: (1) the stronger effluents gravitate from the mill site through an open channel for over a mile where they enter a sedimentation pond into a seepage pit, and then into a pond for retention and controlled discharge on a seasonal cycle; and (2) a system that flows through a primary clarifier located adjacent to the mill and then discharges to a stream course which eventually flows to Maretai Lake and classified waters. The operating cost per ton of pulp is about 68 cents while the unit capital cost per annual ton of pulp is $4.23. (Ellis-Texas)
W71-05011

TREATMENT OF WASTES ORIGINATING FROM METAL INDUSTRIES,
Emschergenossenschaft, Essen (West Germany).
A. Montens.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 908-925. 16 fig, 1 tab, 12 ref.

Descriptors: *Industrial wastes, Metals, *Waste water treatment, Emulsions, Sedimentation, Neutralization, Ion exchange, Crystallization, Salts, Acids.
Identifiers: Cleaving, Hot-rolling-mills, Pickling plants, Regeneration, *Metal wastes.

The wastes of the metal industry, the treatment of wastes of hot-rolling-mills, of pickling plants, and the treatment of aged oil emulsions, including a short look at combustion plants were discussed. The treatment of wastes from hot-rolling-mills involves cleansing the liquid of scale and oil. This is conventionally done by mechanically cleaned settling tanks. Neutralization, ion exchange, regeneration, and crystallization were methods discussed for the treatment of pickling wastes. The treatment of oil emulsions consists of two steps: (1) the cleaving of emulsions, and (2) the separation of oil. Cleaving the oil emulsion can be done by various processes: (1) adding of salts; (2) adding of acids; (3) adding of salts and heating of the emulsions; (4) adding salts and treatment by electricity; and (5) adding of acids and organic cleaving agents. (Ellis-Texas)
W71-05012

POULTRY PROCESSING WASTE TREATMENT AT MILLSBORO, DELAWARE,
Syracuse Univ., N.Y. Dept. of Civil Engineering.
Nelson L. Nemerow.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 526-536. 4 fig, 4 tab, 1 ref.

Descriptors: *Poultry, *Oxidation lagoons, *Organic loading, Algae, Ammonia, Sedimentation, Flotation, Biodegradation, Chlorination, Coliform, Bacteria, Biochemical oxygen demand, Delaware, *Waste water treatment.
Identifiers: Millsboro (Delaware), Swan Creek, Indian River.

9,000 to 10,000 chickens with an average weight of 3.75 lbs are processed during an 8-11 hour working day at Millsboro, Delaware. The wastes from this operation are treated in a two stage oxidation pond with effluent chlorination. Samples were collected in April, June, and December of 1966, and March of 1967. The BOD loading was found to be 1390 lbs/day, with a loading on the first pond of 935 lb BOD/acre. This pond effected a 72.5 percent reduction in BOD. The second pond had a loading of 79 lb BOD/acre, with an additional BOD reduction of 9.5% when algae are not removed from the effluent, and 70% when algae are removed. The overall removal, based on the 4 samples per year, was 92% for the filtered effluent, and 75% when the algae are not filtered out. (Lowry-Texas)
W71-05013

WASTE TREATMENT FOR AN AUTOMATED GRAY NODULAR IRON FOUNDRY,
Caterpillar Tractor Co., Peoria, Ill. Design and Construction Div.
A. J. Bader, and C. L. Meyer.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 468-476. 3 fig, 1 tab.

Descriptors: *Iron, Aeration, Sedimentation, Coagulation, Flotation, Neutralization, Weirs, Chlorination, Biochemical oxygen demand, *Waste water treatment, Illinois, Industrial wastes.
Identifiers: Mapleton (Ill), *Foundry, *Contact stabilization comminution, American Petroleum Institute Gravity Separator, Prefabrication, Lift station.

Caterpillar Tractor Company has designed a new foundry which will utilize water for cooling, dust collection, and a variety of other uses. This plant provides for separation of all difficult to treat waste streams. Oil is burned off in a 'chip dryer', and the remaining wastes are channeled into a batch unit which allows the operator the convenience of determing optimum conditions for each batch. The usual treatment is sedimentation, neutralization, and flotation. Careful control on the part of the operators is necessary in order to maintain the high effluent quality of which the equipment is capable, necessitating the employment of capable dependable operators. A detailed description of both the plant processes and the waste water treatment is included. (Lowry-Texas)
W71-05014

DISPOSAL OF EFFLUENTS FROM PETROLEUM REFINERIES AND PETROCHEMICAL PLANTS,
Bayerische Biologische Verouchsaustalt, Munich (West Germany).
Lothar Huber.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 1009-1024. 6 fig, 3 tab, 10 ref.

Descriptors: *Oil wastes, *Oil, Activated sludge, Effluents, Separation techniques, Oily water, Oil industry, Fuels, Reclamation, Recirculated water, Hydrogenation, Aeration, Coagulation, Waste disposal, Waste water treatment.
Identifiers: *Petrochemicals, Aerated lagoons.

Full integration of in-plant procedures and multistage waste water treatment combined with re-use and reclamation of purified water at five newly constructed petroleum refineries in West Germany has led to considerable progress in pollution abatement. Use of hydrogenation processes, application of improved chemical processes, extensive use of air-cooled heat exchangers, and recirculation have decreased the water treatment and water intake of the plants. Application of pretreatment steps such as stripping, evaporation, equalization of flow, oil separation, and strength of waste waters in skim and surge tanks are practiced. Use of multi-stage biological treatment consisting of low-rate activated sludge plant and an aerated lagoon with a detention time of two days is used. Chemical coagulation can be performed in a separate unit or in the aeration tank of the activated sludge plant for added precipitation. The treatment principles developed in these refineries are being applied in the waste water treatment at a petrochemical plant. (Ellis-Texas)
W71-05015

THE LANCY INTEGRATED SYSTEM FOR TREATMENT OF CYANIDE AND CHORMIUM WASTES IN ELECTROPLATING PLANTS,
Shakespeare Co., Kalamazoo, Mich.
Neal Schreur.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 310-316. 1 fig, 1 tab.

Descriptors: *Chromium, Industrial wastes, Carbonates, Effluents, Hydrogen ion concentration, Costs, Waste water treatment.
Identifiers: Lancy Integrated System, *Cyanide, *Electroplating.

The Shakespeare Company has effectively used the Lancy Integrated System to treat their effluent from plating operations at several plants. This is not an expose on the Lancy system since this system has been reviewed in prior publications but describes the operation at Shakespeare's Kalamazoo Division. A closed loop system is used incorporating the cyanide system, the Chrome I system, and the Chrome II system. The Cyanide system is used following all cyanide bearing baths. The Chrome I system is used primarily for the reduction of hexavalent to trivalent chrome. The Chrome II system is used to polish off any remaining hexavalent chrome and to precipitate the trivalent chrome as a carbonate. (Ellis-Texas)
W71-05016

FIXED ACTIVATED SLUDGE PROCESS FOR INDUSTRIAL WASTE TREATMENT,
Kurita Central Labs., Yokohama (Japan).
K. Kato, and Y. Sekikawa.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 926-949. 17 fig, 6 tab, 14 ref.

Descriptors: *Activated sludge, *Industrial wastes, *Waste water treatment, Aeration, Sedimentation, Sludge, Domestic wastes.
Identifiers: *Fixed activated sludge process, Sludge bulking, Japan.

A series of experimental studies have been conducted to maintain a relatively constant sludge concentration by fixing the suspended flocs of activated sludge on the meshwork of plastic net panels arranged vertically in the aeration tank. This modification is used to prevent sludge bulking and is known as the 'Fixed Activated Sludge Process.' Experiments were conducted on domestic sewage, waste water discharged from a soft-drink bottling factory, and petrochemical wastes from iso-butanol and octanol plants. The FAS process is not only an improvement of the activated sludge process but is also the development of a new unit process of biochemical aeration. (Ellis-Texas)
W71-05017

COAL MINE DRAINAGE TREATMENT,
Jones and Laughlin Steel Corp., Pittsburg, Pa.
E. F. Young, Jr., and H. E. Steinman.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 477-491. 15 fig, 7 tab.

Descriptors: *Acid mine water, *Coal mine wastes, *Mine drainage, *Hydrogen ion concentration, Acidity, Alkalinity, Neutralization, Chemical precipitation, Slurries, Sedimentation, Oxidation, Hydrolysis, Iron, Water table, Pennsylvania, *Waste water treatment, Industrial wastes.
Identifiers: *Yellowboy, Hydrated lime, Holding lagoon, Jones and Laughlin Steel Corporation.

Mine drainage is an extremely variable and complex situation. Discharges analyzed here range from very alkaline to very acidic, from iron contents far beyond the allowable limits to iron contents just above the allowable limits, and so on. Realization that each situation is a separate entity and must have treatment tailored specifically for its needs is essential. Discharges, flow rates, chemical analyses, and treatment methods for several different mine drainage problems encountered by the Jones and Laughlin Steel Corporation are presented here. (Lowry-Texas)
W71-05018

WASTE CONTROL AND TREATMENT BY A CORN AND SOYBEAN PROCESSOR,
Staley (A. E.) Mfg. Co., Ill.
R. V. Willenbrink.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 517-525. 4 fig.

Descriptors: *Corn (Field), *Soybeans, Monitoring, Stabilization, Aeration, Activated sludge, *Waste water treatment, Illinois.
Identifiers: *Process wastes, Population equivalent, Contact stabilization.

Staley's program to reduce the sewer loss of materials has cost the company $150,000 per year in the past two years. Monitoring and waste treatment, two separate phases of the overall program have reduced the daily waste discharge by 50,000 population equivalents/operating day. The three basic components are: (1) careful monitoring for quick isolation of problem areas; (2) efficient waste treat-

ment for concentrated process waste; and (3) support of the management. A thorough explanation of the entire system and the managerial attitudes is included. (Lowry-Texas)
W71-05019

CENTRIFUGES FOR PAPER MILL WASTE SLUDGE DEWATERING,
Mead Corp., Chillicothe, Ohio. Central Research Lab.
W. C. Matthews, George H. Andrews, and John K. Sullins.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 325-333. 5 fig, 3 ref.

Descriptors: *Centrifugation, *Gravity, *Dewatering, Abrasion, *Pulp wastes, Flocculation, Vacuum drying, Oxidation lagoons, Biochemical oxygen demand, Waste water treatment, Ohio.
Identifiers: *Clarification, *Recovery, Hydraulic loading, Detention time, Cyclone cleaner, Suspended solids, Fly ash, Bar screen, Grinder.

Centrifuges have been previously used successfully in the paper industry for solids concentration. They have been used by The Mead Corporation both for dewatering and for recovery of materials such as lime. Solids recovery and discharge solids are functions of: (1) character of the waste, (2) the feed rate, (3) the feed consistency, (4) pond depth, and (5) bowl speed. Feed rates of up to 300 gpm have been handled without flooding, with the optimum being approximately 100 to 150 gpm. Sludge cake averages 40% solids, with solids recovery approaching 90% of the feed. Suspended solids and BOD removals are in excess of 80% and 40% respectively. Problems have been encountered from the standpoint of longevity of the equipment. Grit and fly ash tend to produce excessive wear at speeds for which the centrifuges were designed. Reduction of centrifuge speed necessarily reduces the efficiency of the operation as a whole. Future developments in the field may include new materials used for their wear resistant properties, pretreatment by cyclone cleaners for abrasive removals, or centrifuges in series, each one operating at successively higher speeds causing the abrasive materials to be removed at the slow speeds with a minimum of equipment wear. (Lowry-Texas)
W71-05020

THE DU PONT WASTE LIQUOR PROCESS,
du Pont de Nemours (E. I.) and Co., Wilmington, Del. Industrial and Biochemicals Dept.
Ralph Aarons, and Robert A. Taylor.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 120-125. 5 fig, 1 tab.

Descriptors: *Industrial wastes, *Waste water treatment, *Lime, Steam, Air, Temperature, Hydrogen ion concentration, Gypsum, Waste disposal, *Neutralization, *Oxidation, Iron compounds, Delaware.
Identifiers: Pickle, Waste pickle liquor process, Magnetite.

The problem of disposal of waste liquor produced when sulfuric acid is used to clean, or 'pickle' steel has been solved by the du Pont Company. This process involves continuous neutralization with lime and sinultaneous oxidation of soluble iron to insoluble magnetic iron oxide which provide high-density, low-volume granular solids which are easily separated and disposed of. Gypsum is also produced by this process and has been preliminarily evaluated by a leading manufacturer of wall board and found to be useable. This process is in operation at two steel mills with several more units in the design or construction stage. (Ellis-Texas)
W71-05021

FLUIDIZED-BED PROCESSES - A SOLUTION FOR INDUSTRIAL WASTE PROBLEMS,
Copeland Process Corp., Oak Brook, Ill. Engineering Dept.
John E. Hanway, Jr.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 183-193. 10 fig, 1 tab.

Descriptors: *Industrial wastes, *Pulp and paper industry, Steel, Effluents, Water pollution, Air pollution, Incineration, *Oxidation, *Waste water treatment, Illinois.
Identifiers: *Fluidized-bed process, *Copeland process.

The successful application of the Copeland Process to the treatment of waste effluents from the paper and pulp industry to eliminate stream pollution is described and additional applications have been outlined. Fluidized-Bed Processes represents not only a method to prevent stream pollution, but also a treatment which allows for possible substantial and economic recovery of pulping chemicals. Any waste product containing a combustible constituent represents a promising candidate for the fluidized-bed process. Oxidative processes, by combustion as in the fluidized-bed processes, convert pollution-causing constituents of our wastes into innocuous gases and inert solids which do not cause water or air pollution. (Ellis-Texas)
W71-05022

OAHU WASTE WATER TREATMENT PLANT EFFICIENCY,
Hawaii Univ., Honolulu. Dept. of Environmental Health and Sanitary Engineering.
Reginald H. F. Young, and P. L. Chan.
Journal Water Pollution Control Federation, Vol 42, No 12, December 1970, p 2052-2059. 5 tab, 7 ref.

Descriptors: *Hawaii, *Waste water treatment, Activated sludge, Trickling filters, Chlorination, Disinfection, Lipids, Phosphorus, Nitrogen, Biochemical oxygen demand, Hydrogen ion concentration, Temperature, *Treatment facilities, Hawaii.
Identifiers: *Extended aeration, Suspended solids, Septicity, Oahu (Hawaii).

Waste treatment plants in Hawaii are currently employing primary and primary plus secondary treatment in the form of either trickling filters or activated sludge. Suspended solids removals, BOD5 removals and chlorine residuals all fall with the operational percentage limits reported by other authors for trickling filters and activated sludge and chlorination. At present, there are no facilities for either nitrogen or phosphorus removal, the excess of which is discharged to the effluent. (Lowry-Texas)
W71-05023

PROCURING THE DESIGN DATA IN ORDER TO UPRATE AND OPTIMIZE THE OPERATION OF AN INDUSTRIAL WASTE TREATMENT FACILITY,
American Cyanamid Co., Bound Brook, N.J. Organic Chemicals Div.
James R. Grube.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, July 1968, p 241-251. 3 fig, 3 tab.

Descriptors: *Aeration, *Diffusion, *Industrial wastes, Activated sludge, Pilot plants, Oxygen, Dissolved oxygen, Biochemical oxygen demand, Optimization, Pressure, Oxygenation, *Waste water treatment, *Treatment facilities, New Jersey.
Identifiers: Surface aerators, Diffused air, Bound Brook (NJ).

A program was initiated by the American Cyanamid Company to update their treatment facilities since increased organic loading and hydraulic flow coupled with higher state standards made their treatment plant outdated. A three part program, was initiated to procure the design data to uprate and optimize the secondary treatment facilities which included: (1) activated sludge pilot plant studies to ascertain the feasibility of obtaining the degree of treatment required; (2) small and large scale test work to determine the additional oxygen requirement in the aeration system; and (3) the selection and process design of the aeration equipment for supplying this additional oxygen to the aeration system. (Ellis-Texas)
W71-05024

USE OF STYROFOAM FOR TRICKLING FILTER COVERS,
Dow Chemical Co., Midland, Mich. Plastics Dept.
J. P. Sheahan.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965, Purdue University, Vol XLIX, No 4, July 1965, p 572-582. 11 fig, 2 tab.

Descriptors: *Trickling filters, Odor, Fog, Freezing, Roofs, Construction, Costs, Aesthetics, *Waste water treatment, Biochemical oxygen demand, Michigan.
Identifiers: *Styrofoam, *Spiral generation, Midland (Mich).

A comparison of the efficiencies of covered versus uncovered trickling filters was made by the Dow Chemical Company. It was found that there was some increase in efficiency but not enough to justify covering the trickling filters. Other advantages to covering trickling filters are prevention of freezing, odor control, fog control, lessen the spread of filter flies, and improve appearance. The main disadvantage to covering a trickling filter is the excessive cost which is in the range of $2.75-5.00 per square foot of plan area. (Ellis-Texas)
W71-05025

THE EFFECT OF VARYING AMOUNTS AND RATIOS OF NITROGEN AND PHOSPHATES ON ALGAE BLOOMS,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
For primary bibliographic entry see Field 05C.
W71-05026

UTILIZATION OF RESISTANT PROTEINS BY ACTIVATED SLUDGE,
Seattle Metropolitan Municipality, Wash.
George J. Capestany, and Dale A. Carlson.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, March 1966, p 943-952. 8 fig, 11 ref.

Descriptors: *Proteins, *Aminoacids, *Biodegradation, Protozoa, Rotifers, Pre-Treatment (Water), Colorimetry, Chromatography, Oxidation, Carbon, Nitrogen, Microorganisms, *Activated sludge, Waste water treatment, Washington.
Identifiers: *Keratins, Hair, Disulfide bonds, Flagellates, Amoebas, Sodium hydroxide, Seattle (Wash).

Protein from mammalian hair, hooves and nails, bird feathers, and reptile scales all falls within the general classification of keratins. Keratins are insoluble in hot water, organic solvents, dilute bases and acids, and are resistant to digestion by pepsin and trypsin. Keratin has a high sulfur content in the form of disulfide bonds, forming a dihedryl bond angle of 90 deg and having a bond energy of 60 k cal/mole. To prepare the keratin for testing, it was dissolved in sodium hydroxide to make it available to the microorganisms for biodegradation, sodium hydroxide being tested against other solvents and found to be the best. Results showed considerable variation in the types of microorganisms which were present under different loadings of keratin, but they also showed conclusive evidence that keratin could feasibly be biologically degraded. (Lowry-Texas)
W71-05027

ANAEROBIC AND AEROBIC LAGOON TREATMENT OF PACKING PLANT WASTES,
Stanley Associates Engineering, Ltd., Edmonton (Alberta).
D. R. Stanley.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, March 1966, p 275-283. 2 fig, 3 ref.

Descriptors: Lagoons, *Anaerobic conditions, Aerobic conditions, Industrial wastes, Odor, Scum, *Waste water treatment, *Oxidation lagoons.
Identifiers: *Packing plant wastes, Edmonton, Canada.

An examination was conducted of the development and operation of facilities constructed at Edmonton, Canada which utilized anaerobic lagoons followed by aerobic or storage lagoons. Operating difficulties included: (1) a high hydrogen sulfide production which caused odor and corrosion, and (2) scum accumulation. Anaerobic lagoons can provide economical and efficient treatment of meat packing wastes under sub-zero weather conditions. Effluent from anaerobic lagoons treating meat packing plant wastes has been stored during winter months and discharged in the spring without causing an odor nuisance. (Ellis-Texas)
W71-05028

DETERMINATION OF PROTEIN IN WASTE WATER,
Texas Western Coll., El Paso. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05A.
W71-05029

THE TREATMENT OF REFINERY WASTE WATER WITH PARTICULAR CONSIDERATION OF PHENOLIC STREAMS,
German Shell Co., Hamburg (West Germany).
Wilhelm Steck.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, March 1966, p 783-790. 2 tab.

Descriptors: *Oil wastes, Oil, *Phenol, Ammonia, Desalination, Separation techniques, Flocculation, Flotation, Brines, Biological treatment, Gasoline, Odors, Explosions, Biochemical oxygen demand, *Waste water treatment.
Identifiers: *Refineries, Catalytic cracker, Gas stripping, Re-use, Hamburg, West Germany, Lye.

Scarcity of land in the highly industrialized European country of West Germany has necessitated the construction of petrochemical complexes immediately adjacent to or within heavily populated areas. In view of this fact, increasingly strict air and water pollution laws have been necessary. The petrochemical industries have responded to this situation with a concentrated effort to: (1) reduce the volume of water used; (2) find ways of re-using water from various processes in other processes; and (3) segregate the waste streams so that each waste may be treated in the most efficient manner possible. The areas of greatest effort deal mainly with waste oil and phenols and the methods used in removing or destroying them. The methods used now include gravity separation of oil, flotation/flocculation, and finally biological treatment. (Lowry-Texas)
W71-05030

ENERGY, TOTAL CARBON, AND OXYGEN DEMAND,
Rice Univ., Houston, Tex. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 05A.
W71-05031

THE COMBINED TREATMENT OF PETROCHEMICAL WASTES, GASIFICATION WASTES, AND FISCHER-TROPSCH SYNTHESIS WASTES,
South Africa Coal, Oil and Gas Corporation, Sasolburg (South Africa).
P. R. Loewenstein, and W. P. De Waal.
Proceedings Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 480-494, March 1966. 4 fig, 3 tab, 1 ref.

Descriptors: *Chemical wastes, Sewage, Permits, Flocculation, Filters, Coagulation, Alkalinity, Oil Biochemical oxygen demand, Phosphate, Effluents, *Oil wastes, *Waste water treatment, Costs, Treatment facilities, Standards.
Identifiers: Petrochemical wastes, Gravity separator (API), Latex, Butadiene, Styrene, Ethylene, Gas wastes, South Africa, *Treatment standards, *Combined treatment.

Segregation of storm water and spent cooling water from oil polluted waste streams has significantly reduced treatment costs and increased plant efficiency for a South African Petrochemical Plant. The addition of flocculation facilities has greatly enhanced treatment efficiency in the case of oil and latex polluted waters. A complete description of the geographical location sewer systems, primary and secondary treatment facilities, and effluent discharge constraints is presented. At present, this complex is operating within or nearly within the governmental constraints, but increasingly higher effluent quality standards may soon necessitate further updating of, and addition to the treatment facilities. (Lowry-Texas)
W71-05032

THE EFFECT OF NITRIFICATION OF ORGANIC WASTES ON WATERS IN THE NATURAL ENVIRONMENT-I. EFFECTS OF SEED,
Maine Univ., Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W71-05033

SODIUM HYDROXIDE RECOVERY IN THE TEXTILE INDUSTRY,
Buenos Aires Univ. (Argentina).
Carlos S. Carrique, and Luis U. Jauregui.
Proceedings Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 861-868, March 1966. 4 fig, 1 tab.

Descriptors: *Textiles, *Industrial wastes, Hydrogen ion concentration, Alkalinity, Color, Turbidity, Filtration, Sedimentation, Flotation, Evaporation, Waste water treatment, *Water reuse, Sodium compounds, Costs, Evaporators.
Identifiers: Castelar Textile Mill, Caustic soda, Concentration, Dyeing, Bleaching, Desizing, Mercerizing, Buenos Aires, Argentina, *Sodium hydroxide, *Recovery costs.

High treatment costs for sodium hydroxide effluents, and high replacement costs for sodium hydroxide itself necessitated construction of a system to segregate the sodium hydroxide waste stream and reclaim the sodium hydroxide. This decision was made by an Argentine textile mill, and it resulted in decreased chemical costs both for alum coagulation and neutralization, and it was more economical to reclaim the sodium hydroxide than to replace it. The total net gain is approximately 35 to 40 thousand U. S. dollars per year for a firm handling about 2000 metric tons of cotton per year. The system devised consists of evaporative concentration combined with filtration. Problems were encountered in the original single effect system because the recovered product had a strong color and could not be used for recycle. Also, the use of caustic soda in the plant occasioned many corrosion problems. The addition of a second evaporator, working under a vacuum, made the process a double effect evaporator, and provided both more complete and more efficient treatment of the caustic soda solution. This unit provided re-use of heat from the single effect evaporator, permitted the collection of sodium hydroxide free of color, and avoided the serious corrosion problems. (Lowry-Texas)
W71-05034

REMOVAL OF COD FROM WASTE WATER BY FLY ASH,
Cincinnati Univ., Ohio. Dept. of Civil Engineering.
Prodip K. Deb, Alan J. Rubin, Arthur W. Launder, and K. H. Mancy.
Proceedings Industrial Waste Conference, 21st, May 3, 4, 1966, Purdue University, Vol L. No 2, p 848-860, March 1966. 9 fig, 12 ref.

Descriptors: *Adsorption, *Fly ash, *Activated carbon, Feasibility studies, Pilot plants, Coagulation, Sedimentation, Separation techniques, Hydrogen ion concentration, Biochemical oxygen demand, *Chemical oxygen demand, Ohio, Waste water treatment.
Identifiers: *Refractory materials, Coagulant, Teflon, Hamilton County (Ohio).

Much research on adsorption has been performed recently with activated carbon. However, because of the excessive cost and lack of regeneration procedures for activated carbon, much interest has been developed in a cheaper adsorbent. A comparison of activated carbon versus fly ash, a disposal problem for many coal burning industries, was conducted. The adsorptive properties of activated carbon are far superior to any other commercially available adsorbent, but economic analyses showed that while initial capital costs would be 15% greater, largely due to increased thickener sizes, the long term operating costs for the fly ash plants would be approximately 1/7 of the cost of activated carbon. The capacity of fly ash to remove refractory materials both in batch and continuous flow systems was well demonstrated in this study. The three major system parameters, mixing time, initial COD, and concentration of fly ash were logarithmically related to COD removal. The addition of a small amount of activated carbon significantly enhanced the adsorptive capacity of the mixture. Further studies should be made on a much larger scale to adequately determine the feasibility of fly ash utilization, with respect to its adsorptive capacity, and also the disposal problems associated with the fly ash sludge. (Lowry-Texas)
W71-05035

CONTROL OF WATER AT STRIP MINING OPERATIONS THROUGH SOUND MINING AND RECLAMATION PRACTICES,
Peabody Coal Co., St. Louis, Mo. Forestry and Water Quality.
For primary bibliographic entry see Field 05G.
W71-05036

PLATING AND INDUSTRIAL WASTE TREATMENT AT THE FISHER BODY PLANT,
General Motors Corp., Warren, Mich. Fisher Body Div.
Raymond Fisco.
Water and Sewage Works, 1970 Reference Number, Vol 117, p R236-239, November 28, 1970. 4 p, 4 fig.

Descriptors: *Waste water treatment, *Industrial wastes, *Industrial water, *Water management (Applied), *Lake Erie, Methodology, Planning, Chromium, Water pollution, Streams, Sludge treatment, Acids, Alkalinity, Neutralization, Treatment facilities, Water quality, Water utilization, Chemicals, Reclaimed water, Effluents.
Identifiers: *Fisher Body (Elyria, Ohio plant).

The Fisher Body, Elyria, Ohio plant is a major manufacturer of hardware and electroplated parts for the automobile industry. The treatment plant effluent now averages 1.5 mgd. This discharges into a large storm sewer which in turn joins the Black River one mile east of the plant and is approximately one-fourth mile upstream from Cascade Park. Inasmuch as the Fisher Body effluent flows to a surface stream, the plant is required to operate under the provisions of a permit from the Ohio Water Pollution Control Board at Columbus. The raw waste flow may be described as rather weak solutions of acid or alkali and various suspensions incidental to this type of manufacturing. The flow-through ver-

sus batch-type waste treatment is compared. The importance of segregation of the various types of wastes is emphasized. The flue gas method of chrome waste scrubbing has proven highly effective at this plant. Surveillance and continuous monitoring are likewise extremely important. A valuable adjunct to the system is an aquarium receiving flow from the final effluent stream. (Woodard-USGS)
W71-05085

PROCESS CONTROL TECHNIQUES FOR TREATING ACID MINE-POLLUTED WATERS,
Battelle Memorial Inst., Columbus, Ohio. Environmental Systems Div; and Battelle Memorial Inst., Columbus, Ohio. Chemical Process Development Div.
Syed R. Qasim, Ira L. Whitman, and Robert F. Testin.
Water and Sewage Works, 1970 Reference Number, Vol 117, p R240-R245, November 28, 1970. 6 p, 6 fig, 3 tab, 7 ref.

Descriptors: *Waste water treatment, *Acid mine water, *Industrial wastes, *Appalachian Mountain region, *Water management (Applied), *Industrial water, Mine drainage, Mining, Water pollution, Streams, Mine wastes, Chemicals, Methodology, Water quality, Reclaimed water, Effluents, Acids, Neutralization, Alkalinity, Ion exchange, Chemical analysis, Data collections, Surface waters.

The generalized curves and procedure presented in this paper can be applied to control the chemical feed rates and regeneration cycle of the ion-exchange resin beds in various treatment processes in municipal and industrial water treatment plants which process acid mine polluted waters. The procedure is quite simple since pH and specific conductance are the only parameters required for applying the curves developed in this paper. These can be monitored continuously, thereby eliminating the need for frequent chemical tests to adjust the chemical feed rates. The process of adjusting the chemical feed rates and resin beds regeneration cycle can be computerized, giving a completely automated system. (Woodard-USGS)
W71-05086

BACTERICIDAL EFFECTS OF ALGAE ON ENTERIC ORGANISMS,
Texas Univ., Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 05C.
W71-05155

INVESTIGATION OF A HIGH-PRESSURE FOAM WASTE WATER TREATMENT PROCESS,
Garrett Research and Development Co., Inc., La Verne, Calif.
James K. P. Miller, and L. Karl Legatski.
Copy available from GPO Sup Doc as I67.13/4:17030 ESX 04/70, $0.45; microfiche from NTIS as PB-197 863, $0.95. Water Pollution Control Research Series 17030 ESX 04/70, April 1970. 9 p, 12 tab, 10 fig. FWQA Program 17030 ESX.

Descriptors: *Distillation, *Flotation, *Separation techniques, Saturation, Coagulation, Pressure, Phosphates, Turbulence, Turbidity, Dissolved oxygen, Chemical oxygen demand, Biochemical oxygen demand, Pilot plant, Biodegradation, *Waste water treatment.
Identifiers: *Soluble organics, Particulates, Alum, Ferric chloride, Suspended solids.

The technical and economic feasibility of the separation of organic materials and other contaminants from primary and secondary sewage effluent by a foam fractionation-flotation process was studied. Air-waste water mixtures were held at pressures above 150 psi for from 6 to 25 minutes and then bled to a release vessel where pressures were reduced to atmospheric. Soluble organic and particulate matter collected at the bubble-water interfaces of the fine bubbles being evolved from the supersaturated liquid. Effects of varying flow rate, pressure, contact time, and of different release vessels and additives were studied. 70%, 90%, and 40-80% reductions of COD, phosphates, and suspeneded solids were effected at optimum conditions of air-to-water volume ratios of 2.17 to 1, pressures greater than 175 psi, and with 300-400 mg/l alum or ferric chloride as coagulants. Estimated costs, exclusive of chemicals were 5 cents/1000 gallons for a 10 mgd plant. (Lowry-Texas)
W71-05156

GRANULAR CARBON TREATMENT OF RAW SEWAGE,
FMC Corp., Princeton, N.J.
C. B. Hopkins, W. J. Weber, Jr., and J. Bloom, Jr.
Copy available from GPO Sup Doc as I67.13/4:OPD.17050 DAL 05/70, $1.00; microfiche from NTIS as PB-197 864, $0.95. Water Pollution Control Research Series OPD-17050 DAL 05/70, May 1970. 83 p, 14 tab, 34 fig, 20 ref. FWQA Program 17050 DAL.

Descriptors: *Activated carbon, *Chemical treatment, Coagulation, Sewage treatment, Pilot plant, Adsorption, Biochemical oxygen demand, *Waste water treatment.
Identifiers: *Clarification, Expanded-bed, Packed-bed, Total organic carbon.

A comparison was made of expanded-bed and packed-bed modes of operation of activated carbon adsorption systems in the direct physico-chemical treatment of raw sewage and primary effluent. This project involved extended field testing of a pilot scale treatment system of chemical clarification followed by adsorption. The expanded-bed and packed-bed modes of operation demonstrated essentially equivalent removal of organic matter from the chemically clarified effluent. When a 24 ft. settled depth of activated carbon was used, both systems consistently produced a clear, treated water with an average organic content of only 3-5 mg/l, measured either as TOC or BOD. The expanded bed mode offered several advantages: (1) it eliminates plugging or fouling with particulate matter and air binding; (2) feed pressure remains constant and maintenance requirements are minimal; and (3) it provides an opportunity for a degree of natural aeration. Estimated cost for treating raw waste water in a 10 MGD plant by this process is about 20 cents per 1000 gal. with a total estimated investment of $4,000,000.(Ellis-Texas)
W71-05157

ULTRAFILTRATIVE DEWATERING OF SPENT POWDERED CARBON,
Amicon Corp., Lexington, Mass.
C. W. Desaulniers, and R. W. Hausslein.
Copy available from GPO Sup Doc as I67.13/4:ORD17020 DBA 03/70, $0.70; microfiche from NTIS as PB-197 865, $0.95. Water Pollution Control Research Series, ORD 17020 DBA 03/70, March 1970. 68 p. FWQA Program 17020 DBA.

Descriptors: *Membranes, *Dewatering, *Activated carbon, *Slurries, Shear, Flocculation, Pressure, Separation techniques, Solids content process, Cost analysis, Tertiary treatment, *Waste water treatment.
Identifiers: *Ultrafiltration, Flux, Secondary effluent, Polyelectrolytes.

Spent powdered activated carbon from secondary effluent treatment has been successfully dewatered by continuous membrane ultrafiltration. 5 and 10% carbon solids concentration slurries, using a laboratory size thin channel (0.1 sq ft membrane area), have been dewatered by continuous ultrafiltration to solids levels of 25 to 30%. Dewatering rates ranged between 50 and 100 gal/sq ft per day transmembrane pressures of from 10 to 50 psi during runs as long as 9 days, and product water was invariably free of any syspended carbon solids. The cost of membrane ultrafiltration depends upon the membrane life, and at membrane flux rates of 50 gal/sq ft per day the cost of dewatering carbon from 10 to 20% solids is $0.0015 per pound of carbon with a membrane life of six months, and $0.0035 per pound with a membrane life of only one month. At the present no conclusive data on membrane life is available, but estimates of between 1 and 6 months are quite common and seen to be reasonable. (Lowry-Texas)
W71-05158

DISPOSAL OF TITANIUM DIOXIDE WASTE IN A STRATIFIED ESTUARY,
Norsk Institutt for Vannforskning, Blindern.
Terje Limensen, and Paul Liseth.
Proceedings, Industrial Waste Conference, 22nd, May 2,3,4, 1967, Purdue University, Vol LII, No 2, July 1968, p 950-967. 15 fig, 2 tab, 5 ref.

Descriptors: *Titanium, *Industrial wastes, *Stratification, *Estuaries, Diffusion, Tracers, Acidity, Turbidity, Hydrogen ion concentration, *Waste disposal, Waste water treatment.
Identifiers: *Titanium dioxide, Glomma River, Rhodamin B.

Laboratory experiments established values for the dilution of titanium dioxide before it was dumped into the Glomma River in Norway. Jet diffusion and additional horizontal diffusion in the subsurface layer during the downstream transport were attained. Acidity, turbidity, and precipitation of ferrous iron as hydrous ferric oxide were used as parameters to prevent pollutional effects in the river. In the effluent station the waste is mixed with freshwater from the river to obtain a predetermined density level in the mixture, disposed through diffusers at the bottom of the salt wedge, and enclosed into the brackish water layer by jet diffusion for downstream transport. An efficiency survey using Rhodamin B as a tracer was conducted and indicated that the system was operating as intended. (Ellis-Texas)
W71-05159

ORGANIC POLYMERS IN THE TREATMENT OF INDUSTRIAL WASTES,
Nalco Chemical Co., Chicago, Ill.
John T. Burke, and M.T.Dajani.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, March 1966, p 303-313. 6 fig, 3 ref.

Descriptors: *Coagulation, *Flocculation, *Colloids, Zeta potential, Mobility, Stabilization, Adsorption, Reclamation, *Industrial wastes, Dewatering, Waste disposal, *Waste water treatment.
Identifiers: *Polymers, Thickener, Clarifier.

Polymer flocculants and emulsion breaking chemicals are versatile, but not universal. The individual situation must be considered to determine whether such treatment is both applicable and economical. Advantages of this type of treatment are: (1) relatively simple lab tests or pilot plant test can be used to determine feasibility; and (2) plant results generally follow the pilot plant results to a great extent. The mechanisms of the process, and tests for the feasibility of this treatment method are presented here. Several applications in different situations with different wastes are also discussed. (Lowry-Texas)
W71-05160

EQUALIZATION OF LIQUID WASTES,
Newark Coll. of Engineering, N.J. Dept. of Civil Engineering.
Ivan Metzger.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, March 1966, p 338-347. 7 fig, 13 ref.

Descriptors: *Liquid wastes, Industrial Wastes, *Weirs, Toxicity, Dye releases, Baffles, *Waste water treatment, Settling.

Identifiers: Equalization, Slug, Continuous flow treatment.

A rational approach to the design and construction of equalization tanks for continuous flow treatment was developed by laboratory experimentation. A triangular shaped tank with a weir along one side was proposed and compared with an ideal settling tank. A toxic slug was more efficiently equalized in the triangular shaped tank since a portion of the slug is continuously removed while in a rectangular settling tank all of the slug leaves the tank at essentially the same time. (Ellis-Texas)
W71-05161

A RATIONAL APPROACH TO AN INDUSTRIAL WATER POLLUTION CONTROL PROGRAM,
Minnesota Mining and Manufacturing Co., St. Paul.
Joseph T. Ling, and Charles E. Kiester.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, March 1966, p 314-321. 12 ref.

Descriptors: *Water pollution control, *Industrial wastes, Waste water treatment, Pollution abatement, Pilot plants, Industrial plants.

Reduction of the pollution load through various feasible means is the first step in approaching an industrial waste water pollution control program and includes: (1) plant site selection; (2) waste reduction program; (3) waste survey; (4) waste treatment program; (5) pilot plant study; (6) construction and operation; and (7) continuous monitoring and evaluation. (Ellis-Texas)
W71-05162

EXTREME REMOVALS OF SUSPENDED SOLIDS AND BOD IN TANNERY WASTES BY COAGULATION WITH CHROME TAN DUMP LIQUORS,
Maine Univ., Orono. Dept. of Civil Engineering.
O. J. Sproul, K. Keshavan, and R. E. Hunter.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, March 1966, p 600-612. 5 fig, 4 tab, 8 ref.

Descriptors: *Biochemical oxygen demand, *Coagulation, Lime, Sulfides, Water utilization, *Waste water treatment.
Identifiers: *Tannery wastes, *Suspended solids.

Design criteria was developed for a treatment plant for a chrome tanned cattleskin tannery waste that maximized the removal of suspended solids in addition to BOD removal. A change from the dehairing process utilizing a high lime sulfide to one using a proprietary unhairing compound with less lime and sulfide reduced the total plant BOD and suspended solids by 25 and 45%, respectively. Tests on the plant as it was before and after modification revealed that equalization of plant flows and utilization of the coagulating action of chrome dump wastes gave SS and BOD removals of up to 99 and 50%, respectively, after settling of the waste. (Ellis-Texas)
W71-05163

THE ROLE OF PHOSPHATE IN THE ACTIVATED SLUDGE PROCESS,
Ontario Research Foundation, Toronto. Dept. of Applied Microbiology.
Lorne A. Campbell.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, March 1966, p 214-225. 2 fig, 6 tab, 12 ref.

Descriptors: *Phosphates, *Activated sludge, *Sewage, *Microorganisms, Flocculation, Biological oxidation, *Waste water treatment.
Identifiers: Dispersed growth, Canning wastes, Milk wastes, Metabolites.

An investigation was made of why activated sludge functions as it does. The fact that it does function is an anomoly and is an apprent contradiction of the theory of catalysis. Experimental studies of the effect of yeast extract, glucose, urea, phosphate, amino acids, glutamate, and trace nutrients on dispersed growth of sewage microorganisms were conducted. The results of this study explains why a difficulty is experienced in treating milk plant wastes and vegetable canning plant wastes by orthodox activated sludge procedures. This study, in conjunction with other substantiating research, permits the postulation of the following hypothesis: activated sludge flocs function as reservoirs of metabolites essential to dispersed growth of sewage microorganisms. (Ellis-Texas)
W71-05164

SPRAY IRRIGATION-A POSITIVE APPROACH TO PERPLEXING PROBLEM,
Oxford Paper Co., West Carrolton, Ohio.
W. A. Flower.
Proceedings, Industrial Waste Conference, 20th, May 4,5,6, 1965, Purdue University, Vol XLIX, No 4, July 1965, p 679-683.

Descriptors: *Irrigation, Biochemical oxygen demand, Toxicity, Aquifers, Hydrogen ion concentration, Organic matter, *Water reuse.
Identifiers: *Spray irrigation, Howard Paper Mills.

After two years of pilot plant trials and tribulations, enough knowledge was gained so that a full scale installation was warranted. Many questions had to be answered before a permanent installation was installed which included: (1) what cover crop was most suitable; (2) land requirement; (3) supervision needed; (4) how much water could be applied; (5) what is the tolerance of the cover crop to waste materials; (6) would groundwater become polluted; and (7) disposition of the cover crop. 100% treatment of wastes from the Howard Paper Mills during the low flow season will be provided by a 117 acre spray irrigation system. (Ellis-Texas)
W71-05165

EXTENDED AERATION ACTIVATED SLUDGE TREATMENT OF PETROCHEMICAL WASTE AT THE HOUSTON PLANT OF PETRO-TEX CHEMICAL CORPORATION,
Petro-Tex Chemical Corp., Houston, Tex.
R. D. Pruessner, and J. Mancini.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, March 1966, p 591-599. 3 fig, 3 tab, 10 ref.

Descriptors: *Activated sludge, *Aeration, Pilot plants, Costs, Anaerobic conditions, Sludge, Biochemical oxygen demand, Chemical oxygen demand, *Oil wastes, *Waste water treatment, Oxidation lagoons, Texas.
Identifiers: Extended aeration, Suspended solids, Volatile suspended solids, Houston (Tex).

Laboratory units consisting of continuous flow activated sludge units to provide a rapid evaluation of gross loading and toxicity information, and batch temperature studies were conducted. Two pilot plants consisting of a conventional activated sludge and an extended aeration activated sludge unit were also operated to provide a basis for our final waste treatment plant design. The extended aeration activated sludge treatment unit proved to be the most efficient and removes about 99% of the BOD from the waste stream in a stable system which requires about 3 hours per day operator time. It was also found that the use of an anaerobic pond is an economical method of sludge disposal. (Ellis-Texas)
W71-05167

EFFECT OF ORGANIC WASTE WATER AND COOLING WATER ON SELF-PURIFICATION OF WATER,
Technische Hochschule, Aachen (West Germany).
Botho Bohnke.
Proceedings, Industrial Waste Conference, 22nd, May 2,3,4, 1967, Purdue University, Vol LII, No 2, July 1968, p 752-770. 23 fig, 20 ref.

Descriptors: *Cooling water, *Waste water treatment, *Self-purification, Aeration, Reaeration, Water purification, Industrial wastes, Oxygenation, Organic wastes, Organic loading.
Identifiers: *Lippe River, Lippe Association, Lippeverband, Artificial aeration.

A discussion of the problems involved in the reoxygenation of the Lippe River in West Germany is presented. Analyses of oxygen diagrams at a given load showed that the influence of biologically degradable industrial waste water and the discharge of cooling water exerted on the self-purification capacity of the Lippe River can be estimated with satisfactory accuracy for long stretches of the river. The method of calculating the influence of organic loads on the process of self-purification has proved a valuable help in establishing economical improvement schemes in specific treatment measures, and in fixing contributions. An artificial aeration system was used to maintain the biological balance of this river until adequate treatment facilities could be constructed. (Ellis-Texas)
W71-05168

EFFECTS OF REFRIGERATED STORAGE ON THE CHARACTERISTICS OF WASTE,
San Jose State Coll., Calif. Dept. of Civil Engineering and Applied Mechanics.
F. J. Agardy, and M. L. Kiado.
Proceedings, Industrial Waste Conference, 21st, May 3,4,5, 1966, Purdue University, Vol L, No 2, March 1966, p 226-233. 3 fig, 3 tab, 8 ref. Public Health Service Training Grant 1T1-WP-66-02.

Descriptors: *Refrigeration, *Cooling, *Freezing, Preservation, Water analysis, Storage, Chemical oxygen demand, Biochemical oxygen demand, Respiration, Waste water treatment.
Identifiers: Warburg respirometer, Suspended solids, Volatile suspended solids.

Studies were initiated to determine the effect of refrigerated storage, freezing, and the length of storage under these conditions on standard analyses carried out on wastes. Total solids, suspended solids, volatile suspended solids, COD and BOD were measured at time equals 0, 1 day, and 7 days and only the total solids concentration remained uneffected. A large increase in suspended solids and volatile suspended solids as a result of freezing is a clear indication of the colloidal nature of many waste constituents. A Warburg respirometer was used to investigate the changes in BOD rate constants and ultimate first stage BOD values. (Ellis-Texas)
W71-05169

MODEL OF THE COMPLETELY-MIXED ACTIVATED SLUDGE PROCESS,
Texas Univ., Austin. Dept. of Civil Engineering.
Tom D. Reynolds, and J. T. Yang.
Proceedings, Industrial Waste Conference, 21st, March 1966, Purdue University, Vol L, No 2, March 1966, p 696-713. 8 fig, 7 tab, 6 ref.

Descriptors: *Activated sludge, Respiration, Sludge, *Sewage treatment, *Waste water treatment.
Identifiers: Complete mix, Recycle, Continuous flow, Endogenous respiration, Sludge yield.

A laboratory model was operated to determine the design parameters involved in a completely mixed activated sludge process. The data from the continuous flow unit without recycle fitted the straight line forms of the equations developed which indicated that the equations derived in this study were correct. Equations were developed for MLVSS concentration, the detention time required, the oxygen uptake rate, and an adjustment to laboratory endogenous respiration rates. The design parameters of the sludge yield coefficient and the endogenous respiration rate can be determined from continuous flow laboratory units without recycle or from batch laboratory units using parent sludge from a continuous flow activated sludge unit. The batch tests are to be

preferred because these tests are much quicker and accurate results are obtained from batch tests with much less difficulty than from the continuous flow tests without recycle. (Ellis-Texas)
W71-05171

A MULTI-STAGE FERMENTATION SYSTEM FOR FUNDAMENTAL ANAEROBIC DIGESTION RESEARCH,
British Columbia Research Council, Vancouver.
Frank D. Schamburg, and Edwin J. Kirsch.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, March 1966, p 368-380. 4 fig, 2 tab, 13 ref. Public Health Service Grant WP00760-01, Public Health Service Fellowship 5-F1-WP-22, 348-01.

Descriptors: *Anaerobic digestion, *Methane bacteria, *Fermentation, *Alcohols, Escherichia coli, Metabolism, Cultures, Aluminum, Stainless steel, Cellulose, Temperature, Hydrogen ion concentration, Microorganisms, Waste water treatment.
Identifiers: Methanobacillus omelianski, Dead space, Short-circuiting, Interaction, Teflon.

The mechanisms of the anaerobic digestion were studies by culturing the individual organisms which are present in anaerobic digestion. A multi-stage fermenter, the details of which are presented, was used to grow a pure culture of Methanobacillus omelianski. This bacillus was chosen more for convenience than for being representative of the methane formers. Much additional work is needed to build an improved multi-stage fermenter and to grow bacteria which are more representative of the total system and study the interactions between them. (Lowry-Texas)
W71-05173

A FIELD STUDY OF THE EXTENDED AERATION PROCESS,
Cincinnati Univ., Ohio.
James J. Westrick, James M. Morand, and David J. Eye.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, March 1966, p 424-439. 6 fig, 3 tab, 12 ref.

Descriptors: *Design criteria, *Activated sludge, *Ammonia, *Nitrogen, Oxidation, Rotifers, Protozoa, Sedimentation, Organic loading, Chemical oxygen demand, Biochemical oxygen demand, Waste water treatment, *Aeration.
Identifiers: Extended aeration, Detention time, Hydraulic loading, Sludge handling.

Two extended aeration plants were operated and monitored by qualified research personnel. As a result of this experiment, it was discovered that state standards for construction of these installations will result in under designed plants. Also, it was previously thought that these installations required little or no maintenance. This research established the fact that constant and vigilant professional control is essential to the efficient operation of an extended aeration plant. (Lowry-Texas)
W71-05174

AGRICULTURAL AMMONIA FOR STUCK DIGESTERS,
Washington State Univ., Pullman. Div. of Industrial Research.
Fred Cooper, Ervin Hinden, and Gilbert H. Dunstan.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965, Engineering Bulletin of Purdue University, Vol XLIX, No 4, July 1965, p 126-130. 2 tab, 10 ref.

Descriptors: *Anaerobic digestion, *Ammonia, *Organic acids, *Alkalinity, Methane bacteria, Metabolism, Fermentation, Methane, Temperature, Hydrogen ion concentration, Microorganisms, Waste water treatment.
Identifiers: *Distressed digester, Gas production.

The addition of anhydrous ammonia to stuck digesters to restore favorable microbiological condition has become increasingly popular. While lime may in some cases even favor increased production of volatile acids, anhydrous ammonia does not. Anhydrous ammonia is also more economical in many areas. The conditions leading to digester distress in Pullman, Washington, the remedial action taken with anhydrous ammonia, and the results of this action are presented. Anhydrous ammonia, in this instance, provided virtually complete recovery in 11 days. It must be noted, however, that the appropriate dosage must be carefully calculated and applied in order for this method to be of assistance. (Lowry-Texas)
W71-05175

THE TREATMENT AND DISPOSAL OF RADIOACTIVE WASTES IN AN INDUSTRIAL LABORATORY PLANT,
Farbwerke Hoechst, Frankfurt am Main (West Germany).
Hans Gotte, and Josef Talsky.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965, Purdue University, Vol XLIX, No 4, July 1965, p 504-516. 9 fig, 3 tab.

Descriptors: *Radioactivity, *Radioisotopes, Water pollution treatment, Tritium, Decomposition, Waste dilution, Incineration, Chemical precipitation, Slurries, Filters, Plastics, Pesticides, Solvents, *Waste water treatment.
Identifiers: *Radiochemistry, Carbon-14, Iodine-131, Short-life, Long life, Flume hoods, Carcasses, Dyestuffs, Petrochemicals, Pharmaceuticals, Synthetic fibers.

Radiochemical wastes from one of the largest chemical companies in the Federal Republic of Germany are treated in a centralized treatment plant. Contaminated substances include wash water from hygenic showers, equipment washwater, laboratory animal carcasses, and inlet and outlet air filters. Individual treatment processes for each of these waste sources are discussed, with emphasis placed upon the uniqueness of each situation, and the corresponding necessary to evolve a specialized treatment process for each specialized waste. (Lowry-Texas)
W71-05176

DEHYDROGENASE ENZYME AS A PARAMETER OF ACTIVATED SLUDGE ACTIVITIES,
Texas Univ., Austin.
Davis L. Ford, J. T. Yang, and Wesley W. Eckenfelder.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, March 1966, p 534-543. 9 fig, 1 tab, 5 ref.

Descriptors: *Enzymes, *Activated sludge respiration, Incubation, Organic compounds, Temperature, Hydrogen ion concentration, Waste water treatment.
Identifiers: *Dehydrogenase, Sludge age.

Preliminary tests in the laboratory and in the field indicate that dehydrogenase measurement is potentially a valuable analytical tool. According to the literature and laboratory observations by the authors, cellular dehydrogenase activity is directly associated with its growth phase while this activity and respiration rates follow the same kinetics. In biochemical metabolic pathways, organic compounds are broken down through a series of dehydrogenations which can measure the enzymes by using a tetrazolium salt such as TTC as the hydrogen acceptor. (Ellis-Texas)
W71-05177

CENTRIFUGAL DEWATERING OF PRIMARY PAPER INDUSTRY SLUDGES,
National Council for Stream Improvement, Corvallis, Oreg.
R. O. Blosser, and A. L. Caron.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Engineering Bulletin of Purdue University, Vol L, No 2, March 1966, p 450-456. 5 fig, 1 tab, 2 ref.

Descriptors: *Dewatering, Pilot plant, Retention, *Sludge, Costs, Pulp and paper industry, *Pulp wastes, Coagulation, *Waste water treatment.
Identifiers: *Centrifugal, Vacuum treatment.

Extensive pilot plant work and field installations have revealed some of the factors which affect the efficiency of sludge dewatering such as: (1) bowl speed, (2) detention time in the bowl; and (3) fed sludge consistency. The advantages of the equipment described are: (1) it required little supervision; (2) it is capable of handling wide variations in fed sludge consistency; (3) has a low space requirement; (4) it eliminates the need for chemical conditioning; and (5) the costs are competitive with vacuum filtration. Limitations observed were that trash in the form of chips and sticks cannot be handled and flow rates must be held at a low level on gpm to horsepower ratio to obtain satisfactory solids recovery. (Ellis-Texas)
W71-05178

REGIONAL WASTE WATER MANAGEMENT SYSTEMS,
Massachusetts Univ., Amherst.
R. J. Giglio, D. D. Adrian, F. C. Kaminsky, and R. F. Rikkers.
In: The Proceedings of the Jerusalem International Conference on Water Quality and Pollution Research, p 229-239, June 1969.

Descriptors: *Water quality standards, Decision-making, Mathematical model, Interceptors, Optimization, Stochastic process, Biochemical oxygen demand, Non-linear programming, Economies of scale.
Identifiers: *Waste water treatment systems, Regional planning, Stream vector, System network, Cost function, Cost effectiveness.

The research described is directed toward the development of a methodology and mathematical model to aid planning agencies in regional waste water management. The waste water management system is viewed as a set of subsystems models with unique characteristics. The most basic subsystem is the sewage source or flow with an associated stream vector. The treatment plants of the primary, secondary and tertiary variety are the second subsystem. Other subsystems to be considered are the system network or interceptors connecting treatment plants and sewage sources and the river effluent. The major emphasis is on the manner in which elements of the stream vector change from an input of a subsystem to an output of that system. The author uses economic data on construction and operating costs for waste treatment facilities assuming economies of scale. Results of the work on subsystems determine which plans are feasible subject to cost constraints. A region in Massachusetts has been selected for a pilot study of this model. (Siegenthaler-Rutgers)
W71-05227

TREATMENT OF EFFLUENTS BY ELECTROLYTIC METHODS IN BRITAIN,
M. R. Hillis.
Water and Pollution Control, Vol 108, No 12, p 22-27, December 1970. 6 fig, 9 ref.

Descriptors: *Electrolysis, *Ion transport, *Oxidation-reduction potential, Anodes, Cathodes, Phenols, Copper, Flotation, Toxicity, Electrochemistry, Industrial wastes, Sewage treatment, Waste water treatment, Effluents.
Identifiers: *Great Britain, Pickle liquor, Photographic wastes, Plating wastes.

Electrolysis for treatment of industrial effluents was practiced before 1900 but was abandoned because the technology was not advanced far enough. At the present time, electrolytic treatment is proving extremely beneficial, mainly due to increased technology and experience in the area, to

industrial applications involving ions or ion complexes which are toxic to conventional treatment system bacteria. Examples of both recovery and reuse of valuable materials, and complete destruction of unrecoverable materials are presented. (Ellis-Texas)
W71-05261

FATE OF PHOSPHORUS IN WASTE TREATMENT PROCESSES: ENHANCED REMOVAL OF PHOSPHATE BY ACTIVATED SLUDGE,
California Univ., Richmond. Sanitary Engineering Research Lab.
Arnold B. Menar, and David Jenkins.
Environmental Science and Technology, Vol 4, No 12, p 1115-1121, December 1970. 6 tab, 6 fig, 12 ref.

Descriptors: *Phosphates, *Precipitation, *Carbon dioxide, *Hydrogen ion concentration, Dissolved oxygen, Chemical oxygen demand, Organic loading, Activated sludge, Pilot plant, Waste water treatment, Texas.
Identifiers: *Biological luxury uptake, *Calcium precipitation, *Calcium phosphate entrapment, Carbon dioxide stripping, Phosphorus assimilation, Agglomeration, Sludge volatility, Suspended solids, Rilling Road Plant, San Antonio (Tex).

Activated sludge must contain 2-3% phosphorus by weight in order to grow. Phosphorus removals in excess of this level are caused by chemical precipitation with the phosphate being entrapped in the sludge floc and carried along with it. Precipitation is dependent on sewage pH, which is in turn dependent upon CO2 concentration. If at some point along the length of the aeration basin the DO and pH rise, then precipitation will occur with a resulting phosphorus removal. This phenomena is not dependent upon the conventional operational parameters such as organic loading and mixed liquor suspended solids. (Lowry-Texas)
W71-05262

TREATMENT OF SHIPBOARD WASTES,
New Mexico State Univ., University Park. Dept. of Civil Engineering.
John W. Hernandez, Edward T. Kinney, and Harold H. Singerman.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 880-891, March 1966. 3 fig, 3 tab, 7 ref.

Descriptors: Water pollution sources, *Design standards, *Coliform, *Chlorination, Disinfectant, Peak discharge, Electrochemistry, Biological treatment, Biochemical oxygen demand, *Waste water treatment.
Identifiers: Warships, Small craft, *Shipboard sewage, Flush water, Maceration, Suspended solids, Thermal solids destruction, Electrochemical solids destruction.

Naval vessels of the United States Navy, commercial vessels, and private pleasure crafts can no longer be ignored as pollution sources in coastal waters. An interagency committee within the Federal government has proposed shipboard treatment requirements. Between 10 and 20 gpd of waste per man are produced on ships following a normal work load, as reported by a shipboard waste survey. The maximum flow can be from 200 to 300% of the average flow. Shipboard evaluations of a macerator-chlorinator established the feasibility of using a single unit for multiple fixtures. Data indicates that a substantially coliform-free effluent can be expected, if available chlorine is maintained above 1300 mg/l/flush. (Lowry-Texas)
W71-05263

FLOTATION OF OILY WASTES,
Mobil Oil Co., Trenton, Mich.
Ralph E. Quigley, and E. L. Hoffman.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Engineering Bulletin of Purdue University, Vol L, No 2, p 527-533, March 1966. 3 fig, 4 ref.

Descriptors: *Flotation, *Oil wastes, *Flocculation, Separation techniques, Sedimentation, *Waste water treatment, Lime, Costs.
Identifiers: API separator, Alum.

A general discussion of the theory of primary separation, air flotation, and flocculation of oily wastes is conducted. The waste water system in use at the Trenton Refinery is described along with the results of operation. Flocculation increases the efficiency of the flotation process and alum or lime have given significant improvements in the oil-water separation process. The operating costs of the waste water system have varied but a typical cost would be about 11.5 cents per 1000 gallons. (Ellis-Texas)
W71-05265

PRECIPITATION OF HIGH DENSITY METALLIC HYDROXIDES FOR RECOVERY OR DISPOSAL,
Infilco, Tucson, Ariz.
R. R. Evans.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 511-515, March 1966. 2 fig, 2 tab.

Descriptors: *Chemical precipitation, Metals, *Sludge, *Dewatering, *Waste water treatment.
Identifiers: *Metal hydroxides, DENSATOR, Clarifier.

In an effort to produce a dense, easily dewatered metal hydroxide sludge, INFILCO has developed a proprietary process by the techniques which they have used successfully to produce high density calcium carbonate and magnesium hydroxide sludge in water treatment. INFILCO believes the DENSATOR clarifier incorporates the following principles to an unprecedented degree: (1) it insures completion of the precipitation reaction; (2) it is easily controlled; (3) it produces minimum sludge volume; and (4) it produces a less hydrous sludge which is easily dewatered. (Ellis-Texas)
W71-05266

APPLICATION OF INDUSTRIAL PHOTOSYNTHESIS PROCESS TO WASTE WATER RENOVATION SYSTEMS,
North American Aviation, Inc., El Segundo, Calif. S and ID Life Sciences.
R. H. T. Mattoni, H. Nugent Myrick, and E. C. Keller, Jr.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965. Engineering Bulletin of Purdue University, Vol XLIX, No 4, p 684-705. 17 fig, 1 tab.

Descriptors: *Algae, *Biomass, Water purification, *Protozoa, *Fungi, *Bacteria, Hydrogen ion concentration, Temperature, Alkalinity, Bicarbonates, Bactericide, Kinetics, Hardness, Coliforms, Cytological studies, Evaporation, Microorganisms, California, *Photosynthesis, Waste water treatment.
Identifiers: Industrial photosynthesis, Mean doubling time, Packed cell volumes, Bacterial plate counts, Lancaster (Calif).

Industrial photosynthesis refers to the controlled growth of complex populations of microorganisms, mainly unicellular algae, on complex organic substrates such as primary and secondary waste waters. The goal of this process is to produce salable biomass in addition to increasing the water quality to levels acceptable for irrigational or recreational uses. Three full-scale tank reactors were used to perform experiments on selection processes, pH dependence, and temperature dependence. The natural selection of a simple array of species from a complex seed was demonstrated. pH, however, was shown to have little effect on the relative species frequency profiles. It was also determined that when reactors are operated in an identical fashion, they do produce identical populations of microorganisms. The experiment was situated in an area known for high temperature and cloud free days. During the experiment, however, the region was experiencing its annual temperature minimums, with ice forming on the tops of the reactors. In spite of this, growth rates obtained were comparable to growth rates during the spring, summer, and autumn, demonstrating these systems to be applicable even where freezing temperatures are encountered during part of the diurnal cycle. Finally, the final reductions of bacteria were shown to be a function of algae growth. This was attributed to bacteriocidal enzymes excreted by the algae. (Lowry-Texas)
W71-05267

TRACE METALS AND FILAMENTOUS MICROORGANISM GROWTH,
Kansas Univ., Lawrence. Environmental Health Engineering Lab.
John T. Pfeffer, Aziz A. Samra, and Diann T. Schwegler.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965, Purdue University, Vol XLIX, No 4, p 608-617, July 1965. 5 fig, 5 tab, 15 ref.

Descriptors: *Trace elements, *Microorganisms, Molds, Bacteria, Sludge water analysis, Water chemistry, Water properties, *Waste water treatment.
Identifiers: Filamentous fungi, Sludge bulking.

An investigation of the chemical environment as related to solubility and to the growth characteristics of filamentous microorganisms as related to the presence of trace metals was conducted. As a result of these experiments and literature search it was found that the trace metal requirements for filamentous fungi are different from bacteria and when the trace metal required for bacterial growth is missing, fungi can predominate with sludge bulking occurring. Good fungal growth was obtained in glucose with only iron or zinc present while the presence of copper tended to retard fungal growth. The chemical environment is quite important in controlling the availability of trace metals. (Ellis-Texas)
W71-05268

A FIELD COUNTERCURRENT EXTRACTOR FOR WATER POLLUTANTS,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
Robert L. Bunch, and M. B. Ettinger.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965, Purdue University, Vol XLIX, No 4, p 93-97, July 1965. 2 fig, 1 tab, 1 ref.

Descriptors: Water pollution, *Separation techniques, *Solvent extractions, Pumps, Pressure, Organic matter, Chemical oxygen demand, *Waste water treatment.
Identifiers: Countercurrent extractor, Contactor.

A complete portable liquid extractor has been fabricated for recovering organic pollutants from surface waters. A precise description of these organic pollutants is necessary if we are to deal effectively with today's complex pollutional problems. Most organic pollutants occur in minute concentrations and some means of concentrating these materials is necessary before analysis and identification can be made. Direct solvent extraction would add substantially to the present capability for isolating contaminants from surface water. Podbielniak, Inc. of Franklin Park, Illinois, has fabricated an extractor with necessary pumps, flow meters, pressure gauges, and other accessory equipment mounted on a 6 ft x 10 ft skid which will be mounted on a 14 ft stake bed truck and a separate truck will carry the generator and the solvent to give a completely portable, self-contained unit that can be operated at almost any location. This unit should find use in extracting carcinogenic polynuclear hydrocarbons and pesticides, and in capturing 'slug' doses of organic pollutants in river water. (Ellis-Texas)

W71-05269

PLASTIC TRICKLING FILTER--ACTIVATED SLUDGE TREATMENT OF PAPER WASTES,
Tufts Univ., Medford, Mass. Northeast Research Center.
R. H. Follett.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, and 6, 1965, Purdue University, Vol XLIX, No 4, p 120-125, July 1965. 4 fig.

Descriptors: *Trickling filters, *Activated sludge, *Pulp wastes, *Pulp and paper industry, *Filters, *Organic loading, *Waste water treatment, Solids contact process, Biochemical oxygen demand.
Identifiers: Plastic trickling filter, Loading, Hydraulic load.

A pilot plant implementing the subject process was operated over a two-year period, treating settled effluent from a fine papermill, boardmill, and a papermill employing deinking, the effluent from the latter contained the discharge from both the pulp and the papermills. The pilot plant consisted essentially of those units that are inherent to the activated sludge and trickling filter processes. The combination system provides improved performance, reduced costs and improved settleability. The trickling filter could be used as a cooling tower to cool hot waste to a degree that is amenable to treatment by the activated sludge unit. Operating costs would probably be somewhat lower since the reduction in the aeration power requirement may be greater than the power differential for raising the return sludge to a greater head. The greatest advantage of the combined system appears to be the uniformity of performance at high loading rates. (Ellis-Texas)
W71-05270

LOW PRESSURE WET AIR OXIDATION OF SEWAGE SLUDGE,
Sterling Drug, Inc., Rothschild, Wis. Zimpro Div.
G. H. Telezke.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965. Purdue University, Vol XLIX, No 4, p 40-48, July 1965. 7 fig, 4 tab, 1 ref.

Descriptors: *Pressure, *Temperature, *Oxidation, *Sewage sludge, Filtration, Sands, Filters, Chemical oxygen demand, *Waste water treatment.
Identifiers: Nonputrescible, Sterile, Residue, Specific resistance value.

Low-pressure wet air oxidation provides an economical and flexible method of producing a sterile, readily drainable, and completely acceptable end product for ultimate disposal. The objective of the Zimpro sludge treatment is to produce such a product which is easily concentrated to the minimum volume consistent with the lowest overall treatment and disposal cost. High temperatures (300-400F) and variable pressure (150-3000 psi) are used in this process. Low specific resistance values are indicative of a sludge with rapid characteristics and Swanwick, et al, have made many measurements and determined that the specific resistance value must be reduced to at least 40 x 10 to the 7th power sec sq/g for various sludges. The sludges under wet air oxidation showed x values mostly around 10 x 10 to the 7th power sec sq/g. The low pressure unit should prove to be applicable for the great majority of installations in the U. S. (Ellis-Texas)
W71-05271

ION FLOTATION FOR INDUSTRIAL WASTES: SEPARATION OF HEXAVALENT CHROMIUM,
Illinois Inst. of Tech., Chicago. Dept. of Civil Engineering.
R. B. Grieves, T. E. Wilson, and S. CM. Schwartz.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965. Purdue University, Vol XLIX, No 4, p 110-119, July 1965. 6 fig, 2 tab, 10 ref.

Descriptors: *Chromium, *Foam separation, *Surfactants, Foam fractionation, Separation techniques, Foaming, Tertiary treatment, *Waste water treatment, Industrial wastes, Ions.
Identifiers: EHDA, Bromine, *Chromates, *Dichromates, Concentration, Batch feed, Continuous feed, *Ion flotation.

The objective of this investigation is the establishment of the feasibility of ion flotation (foam separation) for the separation of hexavalent chromium from aqueous solution, using a cationic surfactant which would form an insoluble complex with the dichromate ion. With batch operations, lower residuals of dichromate and of surfactant were obtained than with continuous operation. For continuous operation at a detention time of approximately 150 minutes, a 50 milligram per liter feed stream of dichromate could be split via ion flotation into a foam stream containing 450 milligrams per liter of dichromate and a residual stream containing 15 milligrams per liter of dichromate. The flow rate of the residual stream would be 92% of the feed stream. Greater reductions in the residual dichromate could be achieved by multicolumn operation and by variations in operating variables. (Ellis-Texas)
W71-05272

AUTOXIDATION OF WOOD DISTILLATION WASTES WITH OXYGEN,
Florida Univ., Gainsville. Dept. of Environmental Engineering.
Boyd T. Riley, Jr., John E. Kiker, Jr., and Charles I. Harding.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 926-942, March 1966. 9 fig, 1 tab, 7 ref.

Descriptors: *Acidic water, *Toxicity, Kinetics, Chemical oxygen demand, Phenols, Biological treatment, Chemical degradation, Chromatography, Industrial wastes, Waste water treatment, *Oxidation, *Pulp wastes.
Identifiers: *Autoxidation, Chain reactions, Parr reactor, Antioxidants, Destructive distillation, Charcoal, Retort.

Wood distillation wastes have resisted both biological and chemical treatment. Such wastes have COD's of approximately 100,000 mg/l, a pH of 2-3, and an extremely dark color. While biological treatment is possible, it is not economically feasible, nor is iron coagulation, lime neutralization coagulation following chlorination, extraction, or direct application to unpaved roads. Because air and oxygen are relatively abundant and inexpensive compared to the chemicals needed for some of the other methods, autoxidation was selected as a likely treatment method. Experiments showed temperature to be the most important factor in establishing the rate and completeness of an autoxidation reaction. The first test performed was only of limited success yielding a dilution figure of 1:90 as opposed to 1:100 for the raw waste. The temperature and the pressure were then increased to 260C and 100 psi respectively. The volume of reactor for the first test was 67 liters, and for the second test it was 1.86 liters. This smaller volume had a much higher mixing level, which partially accounted for a conversion rate of 230 mg/l min in the small reactor as opposed to 20 to 30 mg/l min in the larger reactor. As much as 80% treatment of the waste was observed in a period of 10 minutes, while tripling the reaction time increased the percentage to only 87%. The attinability of removals of this range showed that autoxidation of wood wastes does offer considerable promise of being an excellent treatment method for wood distillation wastes. (Lowry-Texas)
W71-05273

THE CONTROL OF ACID MINE DRAINAGE POLLUTION BY BIOCHEMICAL OXIDATION AND LIMESTONE NEUTRALIZATION TREATMENT,
National Coal Board, Yorkshire (England).
H. G. Glover.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1966. Purdue University, Vol L II, No 2, July 1968. 11 fig, 3 tab, 59 ref.

Descriptors: *Mine wastes, *Acid mine water, *Oxidation, *Waste water treatment, Limestones, Neutralization, Sedimentation, Filtration, Costs, Mine drainage, Water pollution control.
Identifiers: *Biochemical oxidation.

A new process for the purification of acid drainage from coal mining operations is described. Novel features include the biochemical oxidation of ferrous salts in acid solution and the application of mechanical attrition to limestone grit which is used for the chemical neutralization of the oxidized drainage. The new process will be most applicable to the more dilute acid drainages for which the conventional lime process is less suitable, and costs of the new process are expected to be appreciably less than the costs of the lime process. (Ellis-Texas)
W71-05274

PERCOLATION OF CITRUS WASTES THROUGH THE SOIL,
Engineering--Science Inc., Arcadia, Calif.
Donald R. Anderson, William D. Bishop, and Harvey F. Ludwig.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 892-901, March 1966. 3 fig, 4 tab, 5 ref.

Descriptors: *Lemons, Industrial wastes, Irrigation, Furrows, *Percolation, Organic wastes, Organic loading, Alkalinity, Conductivity, Aerobic treatment, Chemical oxygen demand, Waste water treatment, California, Waste disposal.
Identifiers: *Lemon Products Division, *Citrus wastes, Suspended solids, Corona (Calif).

Lemon Products Division, of Corona, California, handles an average of 435 tons of lemons per working day. Their processing operations discharge an average daily liquid waste flow of 820,000 gallons, including unused portions of the fruit, and process chemicals used for pH adjustment. The previous method of waste disposal was ponding the wastes in a series of lagoons. This method, generally unsatisfactory because of odor problems, was discontinued in favor of land irrigation. This disposal covers a total of 200 acres, with approximately one-third of this area being used each four month period, and then left fallow or planted to crops. By using furrows, the effluent may be spread evenly over the surface, and the ridges between furrows, which remain exposed to the air, act as air supply ducts to keep the system from going anaerobic. During the operation, the furrows are filled to a depth of approximately six inches, and then allowed to dry. This process is repeated 3 times before the field must be disced and then refurrowed. With a normal average flow of 820,000 gallons/day, and an area of 66 2/3 acres, the depth of water over the surface will be 46 inches, 50% of which evaporates, and 50% of which percolates. Suspended solids are removed almost immediately, and as they build up they clog the soil pores and the liquid moves on down the furrow. After drying and discing these solids become part of the soil. The mean COD loading rate, 13.0124 lb/ft sq/day, is approximately 10 times the loading rate of conventional intermittent sandfilters. (Lowry-Texas)
W71-05275

COMPARISON OF ANAEROBIC-AEROBIC AND AEROBIC LAGOON TREATMENT,
Missouri Univ., Columbia.
D. L. King, and D. R. Bunn.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 248-257, March 1966. 5 tab, 12 ref. Water Pollution Control Administration Training Grant 1T1-WP-30-01A1.

Descriptors: *Aerobic treatment, Aerobic conditions, Anaerobic conditions, Aerobic bacteria, Dissolved oxygen, Carbon cycle, *Biochemical oxygen

demand, Chemical oxygen demand, Energy, *Waste water treatment, *Oxidation lagoons.
Identifiers: *Caloric energy.

Laboratory studies were made in an attempt to describe the degree and type of treatment afforded by an anaerobic-aerobic lagoon system and compare it with the treatment provided by the more widely used aerobic facilities. Parameters investigated include BOD, COD, total caloric energy, and organic solids. The results of testing these parameters indicated that the aerobic cell gave better and more complete treatment than the anaerobic-aerobic series. It was shown during this investigation that BOD is not the best indicator of the amount of organic degradation accomplished within such systems and that another parameter is needed to support BOD data. (Ellis-Texas)
W71-05276

ULTIMATE DISPOSAL OF CONCENTRATED WASTES BY INCINERATION,
Chrysler Corp., Detroit, Mich.
For primary bibliographic entry see Field 05E.
W71-05277

SOME OBSERVATIONS ON LIQUID-SOLIDS SEPARATIONS WITH PARTICLE GROWTH,
Mellon Inst., Pittsburgh, Pa.
H. C. Bramer, and R. D. Hoak.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965. Purdue University, Vol XLIX, No 4, p 423-434. 9 fig, 3 tab, 4 ref.

Descriptors: *Liquids, Sedimentation, *Sedimentation rates, Coagulation, *Suspension, Flocculation, *Separation techniques, Settling, Waste water treatment.
Identifiers: Solids, *Particle growth, Sedimentation index, Electrokinetic properties, Kaolin, Mobility.

The results of experiments conducted to investigate the mechanism of sedimentation with suspensions of a self-coagulating clay are described. The concept of the 'sedimentation index' and an instrumental measure of the electrokinetic properties of suspension were utilized. (Ellis-Texas)
W71-05278

RESEARCH AND DEMONSTRATION PROJECTS IN THE ABATEMENT OF ACID MINE DRAINAGE,
Pennsylvania Dept. of Health, Harrisburg.
For primary bibliographic entry see Field 05G.
W71-05279

EVALUATING THE EFFECT OF INDUSTRIAL WASTES ON LAGOON BIOTA,
Missouri Univ., Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W71-05280

USE OF OXYGEN IN SLUDGE STABILIZATION,
Union Carbide Corp., Tonawanda, N. Y.
J. H. Bruemmer.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 544-558, March 1966. 6 fig, 7 tab, 18 ref.

Descriptors: *Oxygen, *Sludge, *Sludge treatment, Sludge disposal, Nitrogen, Phosphorous, Aerobic conditions, Biota, Chemical oxygen demand, Biochemical oxygen demand, *Waste water treatment, Aeration.
Identifiers: *Stabilization, Total solids, Volatile solids.

Studies were conducted in the laboratory using batch and draw-fill types of treatment systems to compare the use of oxygen with air in the aerobic stabilization of sludge. As a result of these experiments it was found that the use of oxygen is about 10 times more efficient than air per volume of gas sparged when high loadings are distributed over the day in 10 equal portions. Filtrates from aerobic stabilized sludge contain about two mg/l phosphate and about 8 mg/l total nitrogen. The rate that primary sludge can be suitably stabilized under optimal conditions of oxygenation is determined by the biological limitations of the biota. The minimal time for processing raw sludge containing 50,000 mg/l COD in the system described is about four days at 30C. (Ellis-Texas)
W71-05281

PULP MILL WASTE DISPOSAL AT SPECIFIC INSTALLATIONS IN SWEDEN,
Swedish Water and Air Pollution Research Lab., Stockholm.
Stig Freyschuss.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 791-798, March 1966. 5 tab.

Descriptors: *Pulp and Paper industry, *Waste dilution, *Aquatic environment, *Toxicity, Wood wastes, Fibers (Plant), Slurries, Sedimentation, Hydrogen ion concentration, Chemical oxygen demand, Biochemical oxygen demand, Oxidation, Alkalinity, Acidity, *Pulp wastes, Waste water treatment.
Identifiers: *Nymolla Sulphite Mill, *Morrum Sulphate Mill, Bleach, Sweden.

Two pulp mills, located in Sweden, were investigated with regard to the amount of pollution they were producing. Both mills were located in the center of a thriving tourist trade, and both mills discharged their effluents into waters known for sport and commercial fishing. Waste output was analyzed in terms of Kg/ton of pulp as COD, BOD, fiber, and magnesium. Comparisons of these parameters were made for soft wood versus hard wood, with the hard wood generally having the higher values. Data were also collected on the same parameters at the sea disposal outlets from the two plants, and no detectable increase was observed. The overall effects of the effluent from the plant seem to be negligible, and not in any way harming either aquatic or plant life in the area. (Lowry-Texas)
W71-05282

AERATED STABILIZATION OF BOARD MILL WHITE PAPER,
Crown Zellerbach Corp., Camas, Wash.
Herman R. Amberg.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 525-537, March 1966. 4 fig, 9 tab, 6 ref.

Descriptors: *Aeration, Pulp and paper industry, Oxidation lagoons, Biochemical oxygen demand, Biological treatment, Sludge, Industrial wastes, *Pulp wastes, *Waste water treatment, Stabilization.
Identifiers: *Aerated stabilization, Suspended solids.

A survey of the results and comparison of the present operational efficiency of the aerated stabilization lagoon with the efficiency of the original stabilization pond is presented. It was found that by adding aerators to the stabilization ponds an average of 81% of the BOD was removed, a suspended solids reduction of approximately 91%, and a biological sludge production of about 4.5 lbs/lb of BOD removed. The aeration basin, operated as a completely mixed system, was extremely effective in handling wide fluctuations in daily BOD load. Operating costs for the Baltimore treatment plant have been calculated at $0.72/ton of production or $0.0162/lb of BOD removal. (Ellis-Texas)
W71-05283

TOXICITY OF COPPER TO ACTIVATED SLUDGE,
Mead Corp., Chillicothe, Ohio.
K. C. Ayers, K. S. Shumate, and G. P. Hanna.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 516-524, March 1966. 5 fig, 1 tab, 7 ref.

Descriptors: *Activated sludge, *Copper, *Toxicity, Sewage treatment, Industrial wastes, Biochemical oxygen demand, Chemical oxygen demand, Respiration, Sludge, Waste water treatment, Water pollution effects.
Identifiers: Shock loading.

Studies were carried out at The Ohio State University in which attempts were made to investigate the actual mechanism causing partial failure of the activated sludge process due to shock loadings of copper. The following hypotheses were formulated as a result of these investigations: (1) when copper bearing sewage enters the aeration tank there is a rapid redistribution of copper between the available ligands; (2) the copper equilibrium and the toxic effect will depend on copper dosage, MLSS, and influent sewage strength; (3) metabolically inactive copper complexes may be reversed, either by dilution or by the addition of uncomplexed ligands; and (4) the appearance of bacterial cells in the effluent is a result of the toxic effect of sludge. (Ellis-Texas)
W71-05284

TEMPERATURE AND RETENTION TIME RELATIONSHIPS IN THE ACTIVATED SLUDGE PROCESS,
Rutgers - The State Univ., New Brunswick, N.J.
Joseph V. Hunter, Emil J. Genetelli, and M. E. Gilwood.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 953-963, March 1966. 5 fig, 8 tab, 8 ref.

Descriptors: *Temperature, Protozoa, Rotifers, Nitrogen, Evaporation, Biochemical oxygen demand, *Activated sludge, Waste water treatment, *Sludge treatment.
Identifiers: *Retention time, *Synthetic wastes, SVI-Sludge volume index, DNA-Desoxy ribonucleic acid, Filamentous microorganisms, Bulking sludge, Suspended solids.

As effluent standards become more strict, treatment methods previously rejected for economic reasons become more attractive. Temperature and retention time have been, investigated as possibly coming within the economical range in the near future. Increasing temperatures between 4C and 45C effected little change in BOD or SS removal efficiencies, but did result in decreased sludge carbohydrate and volatile matter contents, and increased sludge nitrogen content. Increased temperature also caused increased rotifer and protozoan population, while decreasing filamentous organisms and resulting in less MLSS accumulation. There was no uniform trend either for DNA content or SVI with temperature. Increased retention time caused decreased MLSS accumulation and higher BOD and SS removal efficiencies, while sludge volume index was not directly affected. From this study sludge, DNA content was shown to be better indicator of sludge bulking than the general appearance of the sludge under microscopic examination. (Lowry-Texas)
W71-05285

PURE CULTURE STUDIES OF METHANOGENIC BACTERIA,
Florida Univ., Gainesville.
P. H. Smith.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965. Purdue University, Vol XLIX, No 4, p 583-588, July 1965. 2 fig, 2 tab, 8 ref.

Descriptors: *Cultures, *Bacteria, *Methane bacteria, Oxidation, Oxygen, Microbiology, Sludge treatment, Anaerobic conditions, Aerobic conditions, Hydrogen, Sludge, Waste water treatment.
Identifiers: *Methanogenic organisms, Substrate utilization.

The methods described were developed from the basic procedures of R. E. Hungate and have been successfully applied in the isolation and study of methanogenic bacteria from domestic sewage sludge. Pure culture studies of methanogenic organisms are difficult, owing to the extreme sensitivity of the organisms to molecular oxygen. These organisms can be isolated in pure culture using techniques which adequately control the oxygen tension. Methods for the isolation of hydrogen oxidizing methanogenic bacteria have been described. (Ellis-Texas)
W71-05286

PROJECT SALT VAULT: RADIOACTIVE WASTE DISPOSAL IN A SALT MINE,
Oak Ridge National Lab., Tenn.
W. J. Boegly, R. L. Bradshaw, F. M. Empson, W. C. McClain, and F. L. Parker.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965. Purdue University, Vol XLIX, No 4, p 398-409, July 1965. 8 fig, 6 ref.

Descriptors: *Radioactive waste disposal, Temperature, Heat transfer, Economics, Radioactive wastes, Thermal radiation, Heat, Infrared radiation, Effluent, Pressure, *Waste disposal, Waste water treatment.
Identifiers: Project Salt Vault, Salt mine, The Carey Salt Company.

Chemical reprocessing of power reactor fuel produces a chemically complex and hazardous effluent that cannot be handled by conventional waste disposal methods. Studies on the disposal of high-level liquid and solid wastes were initiated at Oak Ridge National Laboratory (ORNL) to consider the heat transfer from the waste to the salt, the effects of heat and radiation on rock salt, and the economics of an actual disposal facility in a salt mine. The inactive salt mine of the Carey Salt Company of Lyons, Kansas, was chosen as a demonstration site to test and evaluate the engineering and scientific objectives. The waste-handling experience and the salt-flow data obtained in this experiment, when combined with the results of laboratory and theoretical studies on the structural stability of rock salt at elevated temperatures and pressures, should allow the establishment of a basis for the design of an actual disposal facility for optimum use of salt-mine waste. (Ellis-Texas)
W71-05287

5E. Ultimate Disposal of Wastes

PETROCHEMICAL WASTE DISPOSAL,
Department of Health, Edmonton (Alberta).
E. E. Kupchanko.
Man and His Environment, Vol 1, Proceedings of the First Banff Joint Conference on Pollution, The University of Calgary and the Engineering Institute of Canada, May 16-17, 1968, Banff, Alberta, Canada: New York, NY, Pergamon Press, Inc, p 53-65, 1970. 13 p, 8 fig, 42 ref.

Descriptors: *Water pollution sources, *Oil industry, *Oil wastes, *Waste treatment, *Canada, Deep well disposal, Methodology, Oily water, Water quality, Organic matter, Chemical analysis, Biochemical oxygen demand, Activated sludge, Adsorption, Oxidation, Chemicals.

Water pollution from petroleum industries and methods of waste disposal are presented. A nationwide survey in Canada indicated that the net pollution load from petroleum refineries measured as Biochemical Oxygen Demand yielded an approximate industry average of 100 lbs. per 1000 barrels of crude processed. The complexities of the disposal of Petrochemical waste calls for considerable study and evaluation of problems peculiar to each operation. Water reuse is becoming increasingly important because of the added costs of waste treatment. Disposal of mercaptans, hydrogen sulfide, oil, caustic and organic wastes is often troublesome in the petroleum and petrochemical industry and several methods are available for their removal from waste waters. Deep well disposal appears to offer a practical and economical method of disposing of extremely objectionable waste materials. Preliminary evaluation of other methods of treatment such as adsorption and solvent extraction appear, in certain circumstances, to be feasible. (See also W71-04901) (Woodard-USGS)
W71-04903

EGG LAYING HOUSE WASTES,
Steeg (Henry B.) and Associates, Inc., Indianapolis, Ind.
For primary bibliographic entry see Field 05D.
W71-05009

TREATMENT AND DISPOSAL OF EFFLUENT FROM A 450 TON PER DAY KRAFT PULP AND PAPER MILL INTO CLASSIFIED INLAND WATERS,
New Zealand Forest Products Ltd., Tokoroa.
For primary bibliographic entry see Field 05D.
W71-05011

DISPOSAL OF EFFLUENTS FROM PETROLEUM REFINERIES AND PETROCHEMICAL PLANTS,
Bayerische Biologische Verouchsaustalt, Munich (West Germany).
For primary bibliographic entry see Field 05D.
W71-05015

HYDROLOGIC IMPLICATIONS OF SOLID-WASTE DISPOSAL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 05B.
W71-05094

DISPOSAL OF TITANIUM DIOXIDE WASTE IN A STRATIFIED ESTUARY,
Norsk Institutt for Vannforskning, Blindern.
For primary bibliographic entry see Field 05D.
W71-05159

WATER QUALITY, THE STATE OF THE ART,
Wayne State Univ., Detroit, Mich.
For primary bibliographic entry see Field 05G.
W71-05212

PERCOLATION OF CITRUS WASTES THROUGH THE SOIL,
Engineering--Science Inc., Arcadia, Calif.
For primary bibliographic entry see Field 05D.
W71-05275

ULTIMATE DISPOSAL OF CONCENTRATED WASTES BY INCINERATION,
Chrysler Corp., Detroit, Mich.
A. R. Balden.
Proceedings, Industrial Waste Conference, 21st, May 3, 4, 5, 1966. Purdue University, Vol L, No 2, p 581-590, March 1966. 8 fig, 2 ref.

Descriptors: *Ultimate disposal, *Incineration, Solid wastes, Sludge disposal, *Waste disposal, Waste water treatment.
Identifiers: *Fluidized beds, Polymerization.

Brief descriptions were presented of: (1) the procedures by which the pollutants are removed from the liquid plant wastes; (2) a few of the experiments that have been conducted to achieve ultimate disposal of these concentrated waste materials; (3) an installation by which disposal of an oily waste is currently being achieved. Incineration techniques to include fluidized bed, pit, and polymerization are discussed. (Ellis-Texas)
W71-05277

PULP MILL WASTE DISPOSAL AT SPECIFIC INSTALLATIONS IN SWEDEN,
Swedish Water and Air Pollution Research Lab., Stockholm.
For primary bibliographic entry see Field 05D.
W71-05282

PROJECT SALT VAULT: RADIOACTIVE WASTE DISPOSAL IN A SALT MINE,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 05D.
W71-05287

5F. Water Treatment and Quality Alteration

BOVINE SALMONELLOSIS (S. TYHIMURIUM) IN A FEEDLOT OPERATION,
W. C. Oglesby.
Veterinary Medicine/Small Animal Clinician, Vol 59, p 172-174, February 1964. 4 ref.

Descriptors: *Salmonella, *Cattle, Antibiotics, Temperature, Animal diseases, Stagnant water, Mud, Waste treatment, Diseases, Public health, Water pollution effects.
Identifiers: *Feedlot, Diarrhea, Salmonella typhimurium, Necropsy, Medication, Nitrofurazone.

An epizootic of a severe respiratory-enteric syndrome appeared in a feedlot operation of 1,000 head of cattle. Salmonella typhimurium was isolated from the organs of 5 carcasses, 3 fecal specimens, and from mud in a waterhole from which the animals drank. Correction of hygienic conditions, electrolyte supplementation, sulfathiazole medication in the drinking water, and intravenous antibiotics gave only mediocre response. Individual dosing with a nitrofurazone preparation and addition of nitrofurazone to drinking water was successful in eradicating the disease. (White-Iowa State)
W71-04918

BOVINE SALMONELLOSIS ASSOCIATED WITH CONTAMINATED CREEK WATER AND HUMAN INFECTION,
Kansas State Univ., Manhatton. Coll. of Veterinary Medicine.
C. M. Hibbs, and V. D. Foltz.
Veterinary Medicine/Small Animal Clinician, Vol 59, p 1153-1155, November 1964. 6 ref.

Descriptors: *Sewage, *Salmonella, Cattle, Sewage bacteria, Water pollution effects, Streams, Infection, Public health, Diseases, Waste treatment.
Identifiers: Human infection, Nicropsy, Diarrhea, Salmonella typhimurium, Bacteriologic examination, Water samples.

A case of Salmonellosis in calves, which may have been associated with human infection, is discussed. Salmonella typhimurium was isolated from two calves, creek water and one human. Though the origin of the infection was not specifically determined, the findings indicated that untreated house sewage may have been the source. The seriousness of water pollution and some of its ramifications are evident. An education program on water pollution is recommended. (White-Iowa State)
W71-04919

OBSERVATIONS ON THE EFFECT OF THE RE-USE OF BROILER LITTER ON THE INCIDENCE OF MAREK'S DISEASE,
Delaware Univ., Newark.
For primary bibliographic entry see Field 05C.
W71-04927

WATER SUPPLY MANAGEMENT PLAN FOR MUSKEGON COUNTY,
Muskegon County Metropolitan Planning Commission, Mich.; and Bauer Engineering, Inc., Chicago, Ill.

For primary bibliographic entry see Field 06B.
W71-04945

5G. Water Quality Control

FLOW THROUGH A TAILINGS POND EMBANKMENT,
Bureau of Mines, Spokane, Wash., and Idaho Univ., Moscow.
For primary bibliographic entry see Field 08D.
W71-04862

CONTROL OF WATER POLLUTION DURING DAM CONSTRUCTION,
California State Dept. of Water Resources, Sacramento; and Santa Ana Regional Water Quality Control Board, Riverside, Calif.
Charles A. McCullough, and Robert R. Nicklen.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 97, No SA 1, Paper 7927, p 81-89, February 1971. 9 p, 3 fig, 4 ref, append.

Descriptors: *Water pollution control, *Dam construction, *Excavation, *Construction, Silts, Clays, Oily water, Environmental engineering, Silting, Sedimentation, Water pollution sources.
Identifiers: Dam construction problems.

With proper planning, owners can avoid water pollution from sediments and sludge during the construction of dams, cofferdams, docks, bridges, piers, culverts, dikes, weirs, or retaining walls near rivers, streams, or other water ways. Prior to construction they should consider how silts, clays, oils, cements, and other materials might enter the stream from haul roads, from erosion of excavation areas, earthfill, and spoil piles, or during the processes of clearing reservoirs or of diverting streams around foundations. They must consider the effect of construction procedure upon drainage, public water supply, recreational facilities, the fishery, and esthetics. Working with agencies charged with the protection of specific stream uses and with the maintenance of water quality standards, they should specify appropriate pollution control measures in construction contracts and should make certain that bidders understand them. Contract specifications related to pollution control are given. (Knapp-USGS)
W71-04888

MAN AND HIS ENVIRONMENT, VOLUME 1.
Calgary Univ. (Alberta).

M. A. Ward, editor. Proceedings of the First Banff Joint Conference on Pollution, The university of Calgary and the Engineering Institute of Canada, May 16-17, 1968, Banff, Alberta, Canada. New York, N.Y., Perganion Press, Inc., 1970. 196 p.

Descriptors: *Conferences, *Water pollution, *Air pollution, *Environmental effects, Water pollution sources, Industrial wastes, Municipal wastes, Farm wastes, Domestic wastes, Pollutants, Pollution abatement, Planning, Water pollution control.
Identifiers: *Conference (Banff, Canada).

The purpose of the First Banff, Canada conference was to bring together all parties who have an interest in environmental pollution but at different levels; the politicians, the planners, the industrialists, the engineering profession, the biologists and the medical profession. It was hoped that the interchange of ideas between the various groups would lead to a clearer understanding of the whole problem by all and thus assist in its solution, in any given circumstances. Seventeen technical papers covering the political, legal, medical and some general aspects of the overall problem of pollution were submitted by prominent and concerned men from throughout Canada and the United States. These proceedings document the formal program of the Conference. The main topics for the four sessions were as follows: (1) General; (2) Water pollution, (3) and (4) Air Pollution and Urban Waste. (See also W71-04902 and W71-04903) (Woodard-USGS)
W71-04901

LIQUID WASTE IN THE PULP AND PAPER INDUSTRY,
Stanley Associates Engineering, Ltd., Edmonton (Alberta).
For primary bibliographic entry see Field 05D.
W71-04902

PETROCHEMICAL WASTE DISPOSAL,
Department of Health, Edmonton (Alberta).
For primary bibliographic entry see Field 05E.
W71-04903

AGRICULTURE FACES NEW CHALLANGES IN CURRENT ENVIRONMENTAL CRISES,
Department of Agriculture, Washington, D.C. Science and Education.
Ned D. Bayley.
Water and Wastes Engineering, Vol 7, No 11, p F-14 - F-16, November 1970. 4 fig.

Descriptors: Farm wastes, Water, Water resources, Pesticides, Salinity, Sediments, Water pollution control, Fertilizers, Planning.
Identifiers: Soil spoiler.

The responsibility of agriculture in enhancing the quality of the environment is colossal. This is because agriculture, including forestry, involves more natural resources than any other segment of society. Wise planning in the use of land, water, chemicals, and waste disposal techniques must be demanded, and it must be done now. This paper outlines some of the problems and difficulties encountered in dealing with agricultural pollutants. (Christenbury-Iowa State)
W71-04914

OIL POLLUTION DAMAGE TO NAVIGABLE WATERS AND MARINE LIFE GIVES RISE TO MARITIME LIEN WHICH WILL SUPPORT ADMIRALTY ACTION IN REM.
For primary bibliographic entry see Field 06E.
W71-04983

OIL POLLUTION AT SEA,
John O. Ludwigson.
In: Oil Pollution: Problems and Policies, Bureau of National Affairs, Inc, Washington, DC, p 1-20, 1969. 20 p, 1 tab.

Descriptors: *Water pollution, *Oily water, *Ships, *Oil, Legal aspects, Water pollution sources, Water pollution control, Water pollution treatment, Oil industry, Oil wastes, International law, Oceans, Remedies, Legislation, Treaties, International waters, United States, Foreign countries, Foreign waters, Emulsifiers, Detergents, Chemical wastes, Accidents, Rivers and Harbors Act.
Identifiers: *Oil spillage.

After detailing the Torrey Canyon and Ocean Eagle oil spills in England and Puerto Rico, respectively, and delineating the attempts by those governments to clean up the oil and protect the ecology, this article observes that the Torrey Canyon and Ocean Eagle spills are potentially small compared to a spill by a supertanker. In the discussion of legal aspects which follows, the author generalizes that: (1) oil spills are illegal almost everywhere; and (2) a polluter is liable for all costs and damages resulting from the spill. The impact of the Oil Pollution Act of 1961, and Boundary Water Treaty with Great Britain, the Oil Pollution Act of 1924, the Refuse Act, the Federal Water Pollution Control Act, and the Outer Continenal Shelf Lands Act upon oil spills is discussed. It is noted that improved navigation devices and ship design should prevent spills. In a discussion of control and cleanup of spills, the article discusses: (1) physical collection; (2) use of absorbents; and (3) chemical dispersion. A table of chemical emulsifiers for oil dispersion concludes the article. (See also W71-04988) (Hart-Florida)
W71-04989

OIL POLLUTION AND THE LAW,
Max N. Edwards.
In: Oil Pollution: Problems and Policies, Bureau of National Affairs, Inc, Washington, DC, p 21-30, 1969. 9 p.

Descriptors: *Water pollution, *International law, *Water pollution control, *Oil, Oily water, Legal aspects, Ships, Water pollution sources, Oil industry, Oil wastes, Oceans, Remedies, Legislation, Treaties, International waters, United States, Foreign countries, Foreign waters, Pollution abatement, Accidents, Rivers and Harbors Act, International commissions.
Identifiers: *Oil spillage, Water Pollution Control Act.

Noting that the gap between oil technology and law must be closed, this article stresses the dual national and international nature of the oil pollution problem. Viewing the legal capability of dealing with oil pollution, the author discusses: (1) the 1954 International Convention for the Prevention of Pollution of the Seas by Oil, (2) the 1961 Oil Pollution Act, (3) the Federal Water Pollution Control Act, (4) the 1924 Oil Pollution Act, and (5) the Convention on the Territorial Sea and the Contiguous Zone. The author sets forth the specific changes necessary to close the gap and put oil under legal control both in the United States and the international arena: (1) change from a gross negligence or willful standard of liability for oil discharge at sea to a strict liability standard; (2) attach liability to offshore drilling spills; and (3) provide enforcement authority for the Intergovernmental Maritime Consultive Organization. Financial responsibility for oil discharge is strongly advocated. A carrier should be strictly liable for any oil pollution on the seas, and proof of financial responsibility should be required. The author also advocates an international standard for construction of oil tankers. (See also W71-04988) (Hart-Florida)
W71-04990

OIL SPILLAGE PREVENTION, CONTROL, AND RESTORATION--STATE OF THE ART AND RESEARCH NEEDS,
W. H. Swift, C. J. Touhill, W. L. Templeton, and D. P. Roseman.
In: Oil Pollution: Problems and Policies, Bureau of National Affairs, Inc, Washington, DC, p 31-61, 1969. 30 p, 1 fig.

Descriptors: *Water pollution, *Oil, *Technology, *Water pollution effects, Design, Research and development, Materials engineering, Materials testing, Emulsifiers, Detergents, Chemical wastes, Organic wastes, Water pollution sources, Water pollution control, Water pollution treatment, Oil industry, Oily water, Oil wastes, Accidents.
Identifiers: *Oil spillage.

Topics discussed in this article on oil spillage, resulting both from tankers and from offshore production operations, include: (1) technical aspects of tank-vessel design as related to prevention of oil spillage, (2) on-scene control of gross leakage, (3) destruction or recovery of open sea oil slicks, (4) disposal of recovered mixtures, (5) protection of the shore face and estuaries, (6) cleaning of shore face and estuaries, (7) slick surveillance and behavior prediction, (8) effect of oil pollution and treatment agents on marine flora and fauna, and (9) waterfowl recovery methods. The review and analysis is directed primarily toward the technical aspects of oil spillage prevention. The current state of technology is discussed, and specific recommendations are made for research and development in the areas of: (1) contingency plans, (2) oil and hazardous materials information centers, (3) prevention of oil spills, (4) control of oil spillage, (5) restoration, and (6) effects of spillage. (See also W71-04988) (Hart-Florida)
W71-04991

OIL POLLUTION: A REPORT TO THE PRESIDENT.

In: Oil Pollution: Problems and Policies, Bureau of National Affairs, Inc, Washington, DC, p 62-109, 1969. 48 p, 1 bibl.

Descriptors: *Water pollution control, *Oil, *United States, *Pollution abatement, Oily water, Water pollution, Planning, Federal government, Administrative agencies, Water pollution sources, Water pollution treatment, International law, International waters, Oil industry, Legislation, Oceans, Oil wastes, Research and development, Resources, Costs, Transfer, Storage, Pipelines.
Identifiers: *Oil spillage.

Considering it imperative that action be taken to prevent oil pollution catastrophies, the President of the United States directed a study to examine how the resources of the United States could best be mobilized against oil pollution. The resulting report to the President first relates recent oil spillage disasters, such as the Torrey Canyon, and discusses the major sources of danger from oil pollution. Topics analyzed include: (1) water borne sources, (2) waste oils, (3) industrial transfer and storage, (4) pipelines, and (5) offshore mining. The present capabilities of the nation are delineated as relate to: (1) prevention, including legal aspects, technical aspects, industrial aspects, and surveillance and notification; (2) cleanup, including contingency plans, physical cleanup operations, physical and technical capabilities, needed improvements in cleanup capability, and legal aspects of cleanup and cost recovery; (3) action programs; (4) activities underway; and (5) recommendations for early action. The report recommends more effective application of existing technology and, through expanded research and development, improvement of present technology and procedures. (See also W71-04988) (Hart-Florida)
W71-04992

NATIONAL MULTI-AGENCY OIL AND HAZARDOUS MATERIALS POLLUTION CONTINGENCY PLAN.

In: Oil Pollution Problems and Policies, Bureau of National Affairs, Inc, Washington, DC, p 110-134, 1969. 24 p.

Descriptors: *Water pollution, *Oil, *Pollution, *Planning, Oily water, Federal government, Administrative agencies, Administrative decisions, Coordination, Water pollution control, Water pollution sources, Water pollution treatment, International law, International waters, Oil industry, Oceans, United States, Oil wastes, Legislation.
Identifiers: *Oil spillage, *National Pollution Contingency Plan.

President Johnson directed preparation of the National Multi-Agency Oil and Hazardous Materials Pollution Contingency Plan. This chapter in a book on oil pollution problems and policies consists of excerpts from this plan. Effective for all United States navigable waters, the purpose of the plan is to establish a pattern of coordinated and integrated responses to pollution incidents. A national reaction team is established, and federal response operations are divided into four phases: (1) discovery and notification; (2) containment and countermeasures; (3) cleanup, restoration, and disposal; and (4) recovery of damages and enforcement. An on-scene commander, an executive agent, is predesignated to coordinate and direct pollution control activities. Numerous annexes are included in the Plan, titled as follows: (1) summary of legal capabilities available to control oil pollution; (2) national inter-agency committee; (3) joint operations center; (4) ship salvage authority of the U. S. Navy; (5) communications and reports; (6) state and local government and private interests; (7) funding; (8) procedures for reporting information and collecting samples in phase IV operations; and (9) technical information. The federal policy on the use of chemicals to treat floating oils is included. (See also W71-04988) (Hart-Florida)
W71-04993

A SUMMARY OF MASSACHUSETTS STATE LAWS, POLICIES AND PROGRAMS PERTAINING TO WATER AND RELATED LAND RESOURCES.
Massachusetts Water Resources Commission, Boston. Div. of Water Resources.
For primary bibliographic entry see Field 06E.
W71-04996

ACID MINE DRAINAGE RESEARCH AT THE OHIO STATE UNIVERSITY,
Ohio State Univ., Columbus. Dept. of Chemical Engineering.
Edwin E. Smith.
Proceedings, Industrial Waste Conference, 22nd, May 2, 3, 4, 1967, Purdue University, Vol LII, No 3, p 229-240, July 1968. 7 fig, 10 ref. FWPCA Grant WP-00340; OWRR Projects W101 and W102.

Descriptors: *Pyrite, *Iron compounds, Sulfur compounds, Acid water, Mine wastes, Water pollution sources, *Mine drainage, *Oxidation, Waste water treatment, Water pollution control, Ohio.
Identifiers: Pyrite oxidation, Venton County (Ohio).

Ohio State University has been involved in acid mine drainage work since 1956 and a short history of their involvement in this field is discussed. From past experience and discussion of specific projects, an interdisciplinary team approach is still required. Chemical mechanism and microbiological studies were conducted which led to studies of pyrite oxidation on a pilot-plant scale. (Ellis-Texas)
W71-04999

CONTROL OF WATER AT STRIP MINING OPERATIONS THROUGH SOUND MINING AND RECLAMATION PRACTICES,
Peabody Coal Co., St. Louis, Mo. Forestry and Water Quality.
J. A. Deane.
Proceedings Industrial Waste Conference, 21st, May 3, 4, 5, 1966, Purdue University, Vol L, No 2, p 1-3, March 1966. 4 ref.

Descriptors: *Waste disposal, *Mine acids, *Mine drainage, Acid mine water, Mine wastes, Hydrogen ion concentration, *Water reuse, Waste water treatment, Water pollution control.
Identifiers: Diversion ditches, Gob, Coal wastes.

A short discourse of mine water was conduced indicating there are two separate parts to water control at strip mine operations; (1) the handling of wastes from the cleaning plant, and (2) the handling of water at the pit itself. If water from a strip mining operation is handled by the sound mining and reclamation practices outlined in this article there will be no pollutional problem in the receiving streams. (Ellis-Texas)
W71-05036

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 2, SECTION B-HYDROLOGY,
Wisconsin Univ., Madison. Water Resources Center.
A. J. MacCormick, and Gerald J. Stadler.
Available from the NTIS as PB-197 847, $3.00 in paper copy, $0.95 in microfiche. Technical Report OWRR C-1228, 1970. 42 p, 13 fig, 6 tab. OWRR Project C-1228-WIS (1601) (2).

Descriptors: *Water management (Applied), *Rivers, *Reservoirs, *Reservoir operation, Wisconsin, Hydrologic aspects, Industrial plants, Hydrographs, Reservoir storage, Detention reservoirs, Drawdown, Early impoundment, Recreation, Water levels, Late impoundment, River forecasting, Flood control, Low-flow augmentation, Regulated flow, Hydrologic models, Streamflow, Water quality, Computer programs.
Identifiers: *Wisconsin River (Wis).

The physical features of the Wisconsin River Basin and the development of the river and its tributaries are described together with its utilization by hydroelectric plants, pulp and paper mills, other industries, agriculture, municipalities, and recreationists. The storage reservoir system is examined in order to describe the determination of observed flows as a result of reservoir operating rules, control points, seasonal factors and constraints on the system. A simulation model of the flow patterns is developed in order to analyze the effects of flow variation on water quality. Much of the fiscal computation is done manually since the objective is to obtain answers for representative water years having high, medium, and low flow rather than to write a generalized computer program. Using historical data records on storage and flow, a streamflow routing program represents the existing system of storage reservoirs together with the river and its tributaries, and permits alternative procedures for controlling the reservoir levels or for controlling the rate of flow at specific gaging stations. A method for estimating flow augmentation capacity is described. (See also W71-05038 thru W71-05041). (Dorcey-Wisconsin)
W71-05037

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 4, SECTION E - COST FUNCTIONS FOR INFLUENCING WATER QUALITY; SECTION F - RELATION OF PARTICIPATION IN OUTDOOR RECREATION AND PUBLIC ATTITUDES TOWARD WATER QUALITY,
Wisconsin Univ., Madison. Water Resources Center.
Elizabeth L. David, Richard S. Howe, and John T. Quigley.
Available from NTIS as PB-197 845, $3.00 in paper copy, $0.95 in microfiche. Technical Report OWRR C-1228, 1970. 101 p, 7 fig, 34 tab, 38 ref, append. OWRR Project C-1228-WIS (No 1601) (3).

Descriptors: *Water quality control, *Costs, *Estimating, *Wisconsin, *Recreation, *Attitudes, Social aspects, Economics, Water pollution control, Water quality, Waste water treatment, Reaeration, Flow augmentation, Reservoirs, Property values, Cost-benefit ratios, Cost analysis, Surveys, Water pollution effects, Reservoir storage.
Identifiers: *Wisconsin River (Wis), Joint treatment plants.

The first section of this volume (E) describes the estimation of the cost functions for influencing water quality and the second section (F) outlines the relation of the participation in outdoor recreation and public attitudes toward water quality. Cost functions for influencing water quality through the following alternatives are developed: external treatment by municipalities, external treatment for pulp and paper mills, joint facilities, and mechanical aeration. While the cost estimates for municipalities are based on regression curves, the estimate for the mills' joint facilities and aeration are engineering cost-estimates. In the case of the municipalities and the mills discrete levels of primary and secondary treatment are considered. In order to estimate the economic efficiency of joint facilities, estimates were made for the cost of pipelines and joint municipal and mill waste treatment. Engineering-cost estimates are made for mechanical aeration through turbine venting and in-stream aeration. Finally regression estimates were made for the reduction in shoreland values of storage reservoirs resulting from releases for flow augmentation. Section F reports the conclusions of a survey which attempts to identify public definitions of water pollution and participation in water-based outdoor recreation in Wisconsin. (See also W71-05037). (Dorcey-Wisconsin)
W71-05038

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 5, SECTION G - SYSTEMS ANALYSIS OF HYDROPOWER PRODUCTION ON THE WISCONSIN RIVER,
Wisconsin Univ., Madison. Water Resources Center.
Gary G. Storey.
Available from NTIS as PB-197 846, $3.00 in paper copy, $0.95 in microfiche. Technical Report OWRR C-1228, 1970. 299 p, 27 fig, 54 tab, 40 ref, Append 5A, 5B, 6A, 6B. OWRR Project C-1228-WIS (No 1601) (4).

Descriptors: *Powerplants, *Hydroelectric plants, *Economics, Power operation and maintenance, Electric power production, Electric power demand, Reservoirs, Model studies, Simulation analysis, Hydroelectric power, Water quality, Water resources development, Water resources, Costs.
Identifiers: *Wisconsin River (Wis).

Research was made to determine economic cost of hydropower benefits lost due to alteration of river flows to achieve quality objectives and examination of the value of capacity and energy of the Wisconsin River hydropower plants. The methodology in measuring hydropower value was based on the least costly alternative of supplying equivalent electrical energy and capacity, within the context of the overall electricity generating system relying primarily on thermal generation and composed of both public utilities and industries generating power for their specific use. A computer simulated operational model used general hydropower production function and regression equations to estimate the production functions of the system's 26 hydropower plants. Models representing electricity production for the component electric utility systems were based on projections of peak energy demands and total energy demands per month, and projected generation station additions and retirement for the 1970-1990 period. The conclusion is that 1/2 of the hydropower plants were uneconomic producers of electricity due to smaller size, age, and high operational and maintenance costs. However, hydropower is an economical source of electricity for pulp and paper mills when compared to the alternative of purchasing energy. This study is particularly relevant to the Wisconsin River. (See also W71-05037). (Auen-Wisconsin)
W71-05039

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 7, SECTION I - FIVE LEGAL STUDIES ON WATER QUALITY MANAGEMENT IN WISCONSIN,
Wisconsin Univ., Madison. Water Resources Center.
Peter N. Davis.
Available from NTIS as PB-197 850, $3.00 in paper copy, $0.95 in microfiche. Technical Report OWRR C-1228, 1970. 371 p, 1 tab, append A, B, C, D, E, F. OWRR C-1228-WIS (No 1601) (5).

Descriptors: *Legal aspects, *Legislation, *Water pollution control, *Wisconsin, Regulation, Management, Water quality, Administration, Control, Judicial decisions.
Identifiers: *Wisconsin River Basin (Wis).

These studies illuminate the implications of existing law for the establishment of a regional system of water quality management in the Wisconsin River Basin. Two studies examine Wisconsin experience under existing law. One of these reviews the application of the common law and how it has functioned; the other reviews Wisconsin experience in regulating water pollution by the Division of Environmental Protection of the Department of Natural Resources, and the work of conservation wardens in dealing with individual pollution cases. Three studies examine the effects of certain constitutional limitations for possible institutional changes that might be made to manage water quality. The first of these is concerned with the constitutional limitations on the construction and operation of water pollution abatement facilities. The second reviews four alternatives to divert state action to construct and operate such facilities, namely, by a state owned non-profit corporation, a special district, a private corporation, and a cooperative. The third study investigates the constitutional limitations on the use of effluent charges to regulate water pollution. (See also W71-05037). (Fox-Wisconsin)
W71-05040

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 9, SECTION K - AN ANALYSIS OF ALTERNATIVE INSTITUTIONAL PATTERNS FOR MANGING WATER QUALITY ON A REGIONAL SYSTEM BASIS,
Wisconsin Univ., Madison. Water Resources Center.
David C. Ranney.
Available from NTIS as PB-197 848, $3.00 in paper copy, $0.95 in microfiche. Technical Report OWRR C-1228, 1970. 250 p, 6 fig, 1 tab. OWRR Project C-1228-WIS (No 1601) (6).

Descriptors: *Administrative agencies, *Planning, *Wisconsin, *Design criteria, *Management, Coordination, Decision making, Inter-agency cooperation, Organizations, Water quality, Social function, Design, Water quality control, Political aspects, Administration, Water law, Non-structural alternatives.
Identifiers: *Systems concept, *Wisconsin River (Wis), Institutional design, Regional systems.

This study is concerned with the design of administrative arrangements for managing water quality on a regional system basis. It reviews existing water quality decision-making arrangements and presents two case studies on water quality management decisions in Wisconsin to indicate how groups and political parties have functioned in dealing with water quality management. The implications of the regional system approach for the design of administrative arrangements are then examined and design criteria for such arrangements developed on the basis of the current literature on organizational theory. These criteria are then applied in an evaluation of three alternative administrative models. One of these is a simple extension of existing arrangements with the existing Department of Natural Resources operating the regional system. In the second, a regional water quality management agency is envisaged as operating the regional system with the Department of Natural Resources establishing and enforcing standards. The third alternative, characterized as the inter-organizational model, would involve four agencies including a regional management agency, a quasi-judicial body to issue orders and enforce regulations, a conservation-oriented planning and standard-setting agency, and a development-oriented planning and standard setting agency. (See also W71-05037). (Fox-Wisconsin)
W71-05041

POTENTIAL ALGICIDES FOR THE CONTROL OF ALGAE,
Los Angeles County Sanitation District, Calif.
James C. Gratteau.
Water and Sewage Works, 1970 Reference Number, Vol 117, p R24-R61, November 28, 1970. 17 p, 6 tab, 27 ref.

Descriptors: *Algicides, *Water quality control, *Aquatic weed control, *Domestic water, *Surface waters, Water supply, Eutrophication, Algae, Nutrients, Water pollution, Biological treatment, Chemicals, Copper sulfate, Chlorine, Water resources, Methodology, Evaluation, Chemical analysis.
Identifiers: Rosin amine D acetate (RADA).

Problems concerning algae in water supplies and methods of controlling algae growth are discussed. In general, there are three basic methods of algae control: physical, ecological and chemical. Physical methods of control, raking, dragging, pulling, and underwater mowing have been used mainly on floating masses of algae and rooted aquatics. Ecological control of algae involves limitation of one or more of the factors necessary for growth and reproduction: light or nutrient material. Only two chemicals are widely used to control algae in water supplies, copper sulfate and chlorine. In excessive concentrations copper sulfate may poison fish and other aquatic life. Approximately 300 chemicals were screened for toxicity and their effectiveness compared with that of copper sulfate. Data for some of the most promising chemical compounds (for example, rosin amine D acetate) as determined from preliminary screening tests and toxicity studies are tabulated. A bibliography with 418 references is included. (Woodard-USGS)
W71-05083

A SURVEY OF CALIFORNIA COASTAL POWER PLANTS,
Federal Water Pollution Control Administration, Portland, Oreg.
R. W. Zeller, and R. L. Rulifson.
January 1970. 64 p, 16 fig, 4 ref.

Descriptors: *Thermal powerplants, Thermal pollution, Cooling water, *Environmental effects, Intakes, Fishkill, Heat treatment, Temperature, Water pollution effects, *California, Coasts, *Powerplants, Sites, Operations.
Identifiers: *Coastal powerplants, Siting, Shoreline outfalls, Outfalls, Policy.

The Northwest Regional Office, FWPCA, initiated a tour in May, 1969 to obtain information on the sites, operation, and environmental effects of representative coastal powerplants in California. Out of the ten powerplants visited, nine are gas-oil fueled and the tenth is nuclear fueled. The purpose of these surveys is to facilitate development of waste heat discharge requirements and to document environmental changes due to heated discharges and the possible need for changes in discharge requirements. Pacific Gas and Electric Company and S. C. Edison Company have developed standard procedures for the design of intake structures to minimize the losses of small fish. Shoreline intakes reduce fish losses by avoiding the high conduit velocities associated with offshore intakes. The powerplants visited subject their cooling water intake systems to periodic heat treatment to control mussels, clams and other incrustations. Based on temperatures at least 4F above ambient, the heated discharge from the outfalls may effect volumes of water up to 100 acres in area and up to 15 feet thick. A lack of well-defined policies and coordination in regard to site evaluation will preclude considerations of the marine environment as a major factor in the location, design, and operation of powerplants. (Upadhyaya-Vanderbilt)
W71-05118

THERMOELECTRIC GENERATORS POWERED BY THERMAL WASTE FROM ELECTRIC POWER PLANTS,
Federal Water Quality Administration, Corvallis, Oreg. Pacific Northwest, Water Lab.
For primary bibliographic entry see Field 08C.
W71-05121

NEW JERSEY V CITY OF NEW YORK (CITY DUMPING GARBAGE IN OCEAN AS NUISANCE).
For primary bibliographic entry see Field 06E.
W71-05125

SURFACE HEAT EXCHANGE AT POWER PLANT COOLING LAKES,
Johns Hopkins Univ., Baltimore, Md. Dept. of Geography., Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering.
D. K. Brady, W. L. Graves, and J. C. Geyer.
Cooling Water Discharge Project Report No 5, Edison Electric Institute, New York, November 1969. 154 p, 61 fig, 7 tab.

Descriptors: *Thermal pollution, *Cooling water, *Power plants, Forecasting, Winds, Dewpoint, Computers, Diffusion, Solar radiation, Hydraulics, Water pollution control, Cooling, Temperature.
Identifiers: *Heat exchange, Exchange coefficient, Equilibrium, Cooling ponds.

This report describes analytical methods for computing rates of surface heat exchange at power plant cooling lakes. The preparation of data for computer analysis is summarized, and computer produced graphs are extensively used to demonstrate characteristics of the data and relationships for evaluating exchange coefficients and equilibrium temperatures. The main results of the study were: (1) the capacity for cooling lakes to dissipate heat under low wind speed conditions is shown to be appreciable. (2) The equilibrium temperature is shown to be closely approximated by the dewpoint temperature .. (solar radiation divided by exchange coefficient.) The application of these findings to the design of power plant cooling lakes and to the evaluation of hydraulic diffusion rates is discussed. (Upadhyaya-Vanderbilt)
W71-05134

ENVIRONMENTAL MONITORING - BRITISH POLICY AND PROCEDURES,
United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch.
For primary bibliographic entry see Field 05A.
W71-05135

BENEFICIAL USE OF WASTE HEAT-AN EVALUATION,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
R. R. Garton, and A. G. Christianson.
Paper for presentation at Conference on Beneficial Uses of Thermal Discharges, New York State Department of Environmental Conservation, September 18, 1970. 12 p. FWQA Program 16130 FHJ 9/70.

Descriptors: *Thermal pollution, *Beneficial use, Temperature, Organic wastes, Economics, Cooling water, Irrigation, Powerplants, Water pollution control.
Identifiers: *Waste heat, Aquaculture, Space heating.

In the overall environmental ecological framework, a beneficial use of waste heat must help reduce the thermal pollution problem directly or it must provide a profit to help offset the cost of cooling devices. Only aquaculture, agriculture and integrated agro-industrial complexes fit this categorization. There is a successful small scale commercial plant in Texas where catfish are raised in cages in a powerplant discharge canal which maintains suitable temperature for optimum growth. Marine fishes have been raised in warmed sea water in Scotland and shrimp in warm powerplant effluent in Florida. The problem of organic pollution has been largely ignored in past aquaculture studies. In a recently completed study in the Pacific Northwest, it was found that 114 hatcheries were releasing approximately 23 tons of BOD per day. In the future a more conscious optimization of distribution, irrigation and heating systems will be required. Pollutional side effects of warm water irrigation could include, changes in temperature or chemical characteristics of groundwater, spreading of pesticides and stream warming through short circuiting of return water. Another possible use of waste heat is spaceheating. The two discouraging factors for this use are the low temperature of typical powerplant waste water and relatively low load factor of space heating systems. (Upadhyaya-Vanderbilt)
W71-05139

NEW JERSEY V CITY OF NEW YORK (OFFSHORE SEWAGE SLUDGE DISPOSAL).
For primary bibliographic entry see Field 06E.
W71-05146

PERMITS FOR DISCHARGES OR DEPOSITS INTO NAVIGABLE WATERS.
Corps of Engineers, Washington, D.C.
For primary bibliographic entry see Field 06E.
W71-05184

ECOLOGY OF SCHISTOSOME DERMATITIS IN WESTERN AND NORTHERN NEVADA WATERS,
Nevada Univ., Reno. Center for Water Resources Research.
For primary bibliographic entry see Field 05A.
W71-05194

SINCLAIR REFINING CO V BENNETT (POLLUTION OF WELLS BY GASOLINE LEAK).
For primary bibliographic entry see Field 06E.
W71-05207

WATER QUALITY, THE STATE OF THE ART,
Wayne State Univ., Detroit, Mich.
Henry Dirasian.
Urban Affairs, Vol 6, No 2, p 199-212, Dec 1970.

Descriptors: *Water quality, Water supply, Water pollution, Waste water treatment, Biochemical oxygen demand, Tertiary treatment, Cost allocation.
Identifiers: *Recycling, Disposal costs.

The problems of water pollution control and solid waste disposal are considered. An analysis of the technology of primary and secondary waste water treatment is given with the main impact of secondary treatment being on the further reduction of biochemical oxygen demand (BOD) of the waste water. Techniques for tertiary treatment are described with stress on filtration techniques and electrical processes. The author compares solid waste disposal and waste water treatment and suggests solid waste recycling can be profitable while waste water treatment costs are a municipal burden. Water quality standards established by the State of Michigan Water Resources Commission are discussed by the author to illustrate the relation between uses of streams and the amount of contaminants allowable for water supply, recreational, agricultural, and commercial purposes. The author finds waste water treatment problems are no longer of a technical nature but due mainly to insufficient cost allocation by municipalities and industrial plants. (Siegenthaler-Rutgers)
W71-05212

THE QUALITY OF THE URBAN ENVIRONMENT,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06G.
W71-05214

SPECIAL PROBLEMS OF METROPOLITAN WATER RESOURCES ANALYSIS,
Chicago Univ., Ill.
For primary bibliographic entry see Field 06B.
W71-05225

REGIONAL WASTE WATER MANAGEMENT SYSTEMS,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 05D.
W71-05227

LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
Cornell Univ., Ithaca, N.Y.
Daniel P. Loucks, Charles S. Revelle, and Walter R. Lynn.
Management Science, Vol 14, No 4, p 166-181, December 1967.

Descriptors: *Linear programming, Water pollution control, Stream flow, Waste water treatment, Biochemical oxygen demand, Oxygen sag, Economic evaluation.
Identifiers: *Cost minimization, Objective function, Linear constraint, Differential equation.

Two linear programming models are presented to discover the least cost combination of waste water treatment facilities required to meet any set of stream dissolved oxygen standards within a river basin. The dissolved oxygen parameter of stream quality is used to measure and limit the amount of pollution resulting from organic wastes. The models are derived from the Streeter-Phelps oxygen sag equations used to describe the rates of dissolved oxygen depletion and recovery of streams. The solution of the models indicates the design efficiencies required for each waste water treatment facility in order to maintain a specified set of oxygen concentrations. These models can be used to evaluate the sensitivity of cost and quality to any changes in stream and waste water flow conditions. The models can point out those locations along a stream where the discharge of waste water effluent results in a minimum increase in the total cost of the required waste water treatment. (Siegenthaler-Rutgers)
W71-05236

THE INDUSTRIAL POINT OF VIEW,
Iowa Univ., Iowa City.
H. Sidwell Smith.
In: Water Pollution Control and Abatement, Ames, Iowa State University Press, 1967, p 134-144.

Descriptors: *Industrial wastes, *Water pollution, *Economic evaluation, Municipal wastes, Waste treatment, Cost-benefit analysis, Water quality standards, Surface runoff, Sewerage, Technology, Social aspects, Population.
Identifiers: *Iowa, Economic base, Industrial waste trends, Economic growth.

Iowa industry generates an amount of organic wastes which have a pollution effect of more than twice the present population. In addition, a large amount of inorganic waste is also present. However, the present situation is such that the nature of control and regulation can be largely preventive rather than exclusively corrective. This is due to the relatively even distribution of industrial activity throughout the state. The principal problems are those associated with formulation and implementation of policy concerning the use of the state's water resources. Conflicting uses must be evaluated and the effect of different waste constituents on other uses of water resources analyzed. Unique problems are created by the differences in the economic base between industrial and public areas and these must be recognized in cost-benefit analyses and method comparison. The tendency for these differences to favor low-investment operations with high operating costs must be prevented. (Murphy-Rutgers)
W71-05242

WATER QUALITY AND MAN'S ENVIRONMENT,
Federal Water Pollution Control Administration, Kansas City, Mo.
Herbert C. Clare.
In: Man and the Quality of His Environment, Boulder, University of Colorado Press, 1968, p 47-58.

Descriptors: *Water pollution, *Waste treatment, *Federal government, Costs, Economic evaluation, Water quality, Management, Population technology, Water law, Social aspects, Waste treatment.
Identifiers: *Economic growth, *Waste philosophy.

A review is conducted on the federal government's role in controlling water pollution, and the changes in public attitude toward water resources brought about by changes in the economic environment and the need for efficient water management. The Water Quality Act of 1965 and the Clean Water Restoration Act of 1966 have marked change in public awareness of the problem brought about by increased population paralleling in industrial and

technological expansion. The economic progress of recent years has changed water from a free good to one whose cost is steadily rising. The relevant question is whether this cost should be borne by the water user or the waste discharger. The author discusses this basic problem and argues in favor of the latter approach. (Murphy-Rutgers)
W71-05243

PROCEEDINGS, CONFERENCE ON HAZARDOUS CARGOES, U. S. COAST GUARD ACADEMY, NEW LONDON, CONNECTICUT ON 8-9 JULY 1970.
National Research Council, Washington, D.C. Committee on Hazardous Materials.
For primary bibliographic entry see Field 05B.
W71-05260

THE CONTROL OF ACID MINE DRAINAGE POLLUTION BY BIOCHEMICAL OXIDATION AND LIMESTONE NEUTRALIZATION TREATMENT,
National Coal Board, Yorkshire (England).
For primary bibliographic entry see Field 05D.
W71-05274

RESEARCH AND DEMONSTRATION PROJECTS IN THE ABATEMENT OF ACID MINE DRAINAGE,
Pennsylvania Dept. of Health, Harrisburg.
J. J. Buscavage.
Proceedings, Industrial Waste Conference, 20th, May 4, 5, 6, 1965. Purdue University, Vol XLIX, No 4, p 664-672, July 1965. 2 fig.

Descriptors: *Coal mine wastes, Mine acids, Mining, Water pollution sources, Abatement, *Mine drainage, Strip mine wastes, Pennsylvania, *Water pollution control, Waste water treatment.
Identifiers: Retreat mining, Monongahela River, Susquehanna River.

A brief description of some of the twenty mine drainage research or demonstration projects being carried out in Pennsylvania is presented. The Monongahela River Mine Drainage Project, the El Camton Strip Mine Reclamation Project, the Wetmore Coal Study, Retreat Mining, the Tom's Run Project, the Slippery Rock Creek Survey, the Coal Research Board Projects, the Buttonwood Overflow Study, the Butler Water Tunnel Study, the Flow Augmentation Study, and the Watershed Reclamation Demonstration Project are discussed. (Ellis-Texas)
W71-05279

WATER PROBLEMS IN OIL PRODUCTION,
L. C. Case.
Tulsa, Oklahoma, Petroleum Publishing Company, 1970. 133 p.

Descriptors: *Flooding, *Oil industry, *Water pollution, Oily water, Water quality, Pitting (Corrosion), Scaling, Brackish water, Water analysis.
Identifiers: *Oil-field waters, Filtration, Common waterflood problems, Waterflooding, Pollution avoidance, Corrosion prevention, Graphitic corrosion, Sweet-oil (Organic acid) corrosion, Carbon dioxide corrosion.

The book is the first definitive volume ever published on oil-field water problems. It embraces more than 40 years of intensive experience with a number of petroleum companies and in a variety of situations. Following an uncomplicated discussion of water chemistry, the book covers solid deposits and scale formations, and corrosion causes, prevention and treatment. Subjects such as plugging or fouling deposits, filtration, identification of common water problems, and injection-water specifications are examined in detail. Attention is also given to avoiding pollution, combatting unjust claims, and to establishing criteria for evaluating qualified services for water problems. (Campbell-NWWA)
W71-05295

SUMMARY OF OUR PRESENT KNOWLEDGE OF THE PHYSICAL PROCESSES OF MIXING IN THE OCEAN AND COASTAL WATERS, AND A SET OF PRACTICAL GUIDELINES FOR THE APPLICATION OF EXISTING DIFFUSION EQUATIONS IN THE PREPARATION OF NUCLEAR SAFETY EVALUATIONS,
Atomic Energy Commission, Washington, D.C., AND Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Institute.
For primary bibliographic entry see Field 02L.
W71-05324

OIL SOAKED STRAW HARVESTING TECHNIQUES,
Marsan Corp., Elgin, Ill.
John D. Harper.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C., American Petroleum Institute Publication No 4040, p 249-251.

Descriptors: Oil wastes, *Absorption, *Mechanical control, *Cleaning, Water pollution control.
Identifiers: *Harvesting techniques, Straw, *Oil pollution, Coastal pollution.

Mechanical recovery of oil pollutants is reviewed with emphasis on straw as an absorbent material and methods for the harvesting of the oil soaked straw. State-of-the-art harvesting techniques are complicated by the many varying circumstances surrounding oil pollution incidents. The development of new harvesting equipment to be used by various types of vessels will permit wider and more effective usage of straw in oil pollution control. (See also W70-10035) (Ensign-PAI)
W71-05325

PREVENTION OF POLLUTION BY OIL AND HAZARDOUS MATERIALS IN MARINE OPERATIONS,
Coast Guard, Washington, D.C. Electrical Engineering Branch.
Albert G. Stirling.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C. American Petroleum Institute Publication No 4040, p 47-53. 2 tab, 1 ref.

Descriptors: *Pollution abatement, *Oil, *Accidents, *Legislation, Education, Engineering, Water pollution control.
Identifiers: Cleanup, Enforcement, Oil pollution, Hazardous materials pollution.

The causes of pollution by marine operations can be deliberate, carelessness, or unavoidable accidents. Corrective measures are discussed within the realm of necessity, effectiveness and practicality. The best solution is prevention when possible, and cleanup methods when prevention is unrealistic. Education, engineering and enforcement are needed to effect these solutions. Legislation and international treaties concerning pollution by marine operations is summarized. (See also W70-10035) (Ensign-PAI)
W71-05326

PORTLAND HARBOR EVALUATION,
Maine Port Authority, Portland.
A. Edward Langlois, Jr.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C., American Petroleum Institute Publication No. 4040, p 233-236.

Descriptors: *Oil wastes, *Water pollution control, *Harbors, *Cleaning, *Barriers, Mechanical control, Evaluation.
Identifiers: Oil pollution.

The Portland Harbor Pollution Abatement Committee Inc. submitted a study proposal to the Federal Water Pollution Control Administration and was awarded a grant to study mechanical and pneumatic barriers to contain spilled oil and means of removing the contained oil. The findings from this research will result in a unique manual for on-the-scene oil pollution control. Advanced testing will continue involving the movement of hundreds of vessels for the transportation and handling of petroleum products. Equipment manufacturers and leading figures in pollution control are participating in the study. (See also W70-10035) (Ensign-PAI)
W71-05327

EVALUATION OF DISPERSANTS,
British Petroleum Co. Ltd., London (England). Research and Technical Development Dept.
L. R. Beynon.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C., American Petroleum Institute Publication No. 4040, p 209-215. 4 fig, 3 tab.

Descriptors: *Oil wastes, *Water pollution control, Cleaning, Chemicals, Evaluation, Dispersion, *Oil-water interfaces, Oily water.
Identifiers: *Dispersants, Oil pollution.

The way in which dispersants work is that they change the interfacial properties of oil and water, breaking up an oil layer into very small droplets by agitation which is dispersed into the sea. Application and techniques for supplying agitation to the treated oil differ depending on whether the oil is floating or has come ashore. Often dispersants which are very effective for floating oil may be of no use in dealing with beach cleaning, however the reverse is not necessarily true. Separate methods of evaluating the effectiveness of dispersants at sea and on shore are indicated. (See also W70-10035) (Ensign-PAI)
W71-05328

EVALUATION OF THE EFFECTIVENESS OF OIL-DISPERSING CHEMICALS,
Federal Water Pollution Control Administration, Edison, N. J. Water Quality Lab.
T. A. Murphy, and L. T. McCarthy.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C., American Petroleum Institute Publication No 4040, p 199-207. 7 fig, 4 tab, 19 ref.

Descriptors: *Oil wastes, *Water pollution control, *Cleaning, Chemicals, Laboratory tests, Evaluation, Dispersion, *Emulsifiers, Oily water.
Identifiers: Effectiveness evaluations, *Dispersants, Oil pollution.

An evaluation method for the effectiveness of oil-dispersing chemicals has been developed. The apparatus was originally designed for Navy specification for solvent-emulsifiers and has been adapted to correspond to typical environmental conditions. Type of oil, composition of salt water solution, degree of agitation of chemical-oil mixture, and the amount of contact between chemical and oil before agitation were the conditions demonstrating most effect on dispersment. Results from this procedure (the Simulated Environmental Tank Test) are in accord with results from field tests. (See also W70-10035) (Ensign-PAI)
W71-05329

LABORATORY EVALUATION OF CHEMICAL OIL DISPERSANTS,
Ontario Water Resources Commision, Toronto.
A. Oda.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C., American Petroleum Institute Publication No 4040, p 193-197. 3 fig, 11 ref.

Descriptors: *Oil wastes, Water pollution control, *Cleaning, Chemicals, Laboratory tests, Evaluation, Dispersion, Oily water.
Identifiers: Effectiveness evaluations, *Dispersants, Oil pollution.

Methods to evaluate chemical oil dispersants for obtaining preliminary data as to their effectiveness as dispersants and the resulting problems from their use are presented. Most of the techniques are quite simple, such as, jar tests, bioassays, oxygen uptake measurements and threshold odor determinations. Data is of value when the selection of a dispersant must be made with only limited knowledge and experience. (See also W70-10035) (Ensign-PAI)
W71-05330

DISPERSANT TOXICITY TEST PROCEDURES,
Ministry of Agriculture, Fisheries and Food, Burnham-on Crouch (England). Fisheries Lab.
For primary bibliographic entry see Field 05C.
W71-05331

LIMITED OIL SPILLS IN HARBOR AREAS,
Naval Facilities Engineering Command, Norfolk, Va. Atlantic Div.
J. Stephen Dorrler.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C., American Petroleum Institute Publication No 4040, p 151-156. 5 fig, 11 ref.

Descriptors: *Oil wastes, *Cleaning, *Harbors, *Cost analysis, Costs, Water pollution control.
Identifiers: Limited spills, Oil removal costs, Oil pollution.

Limited oil spills are numerous and occur frequently, they require proper treatment, and are expensive to treat. The physical conditions affecting an oil spill, the type of equipment used, and the extent of the removal operations are contributing factors to the high cost of cleaning up limited oil spills. At the time of the writing of this paper the typical limited oil spill costs the Navy over $1,000 to clean up. This cost will increase as control agencies of Harbor water quality require more complete removal and cleanup. (See also W70-10035) (Ensign-PAI)
W71-05333

UNITED KINGDOM OIL INDUSTRY RESEARCH AND PLANS TO DEAL WITH SEA POLLUTION BY OIL,
Esso Petroleum Co. Ltd., London (England).
H. Jagger.
Prevention and Control of Oil Spills, Joint Conference, Proceedings, New York, New York, December 15-17, 1969, Co-sponsored by American Petroleum Institute and U.S. Federal Water Pollution Control Administration, Washington, D.C. American Petroleum Institute Publication No 4040, p 23-26. 3 ref.

Descriptors: *Pollution abatement, *Oil industry, *Governments, Water pollution control.
Identifiers: Institute of Petroleum, United Kingdom, Inter organization liaison, Tanker industry, International organizations, Oil pollution.

The Institute of Petroleum coordinates the United Kingdom oil companies on the prevention of pollution by oil and provides a link between these oil companies, government departments, the tanker industry and several international organizations. The institute's provisions for the exchange of knowledge and opinions on technical matters of a non-commercial nature relating to the oil industry and its link between government departments and the United Kingdom oil industry on many technical matters from measurement, sampling and testing to the conditions of license for the storage of petroleum spirit are reviewed. The development of the institute's role of oil pollution prevention and the present position of cooperative research and response plans are presented. (See also W70-10035) (Ensign-PAI)
W71-05334

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

MATHEMATICAL MANAGEMENT MODEL--UNCONFINED AQUIFER,
Texas Tech Univ., Lubbock. Water Resources Center; and High Plains Underground Water Conservation District No. 1, Lubbock, Tex.
For primary bibliographic entry see Field 02F.
W71-04931

SIMULATION THEORY APPLIED TO WATER RESOURCES MANAGEMENT,
Nevada Univ., Reno. Center for Water Resources Research.
W. S. Butcher, V. L. Gupta, J. W. Fordham, and R. E. Miller.
Available from NTIS as PB-197 849, $3.00 in paper copy, $0.95 in microfiche. Nevada University Desert Research Institute Technical Report Series H-W, Publication No 7, September 1969. 56 p, 11 fig, 4 tab, 44 ref, 4 append. OWRR Project C-1105 (1582) (1).

Descriptors: *Systems analysis, *Optimization, *Water resources development, Water management (Applied), California, Nevada, Deserts, Arid lands, Irrigation design, Irrigation efficiency, Mathematical models, Simulation analysis, Synthetic hydrology.
Identifiers: Truckee River System (Calif-Nev).

Criteria were developed for management decisions affecting the optimization of complex river system. A NUMBER OF NEWLY—DEVELOPED TOOLS IN THE FIELD OF WATER RESOURCES PLANNING WERE CRITICALLY EVALUATED FOR USE UNDER REALISTIC SITUATIONS. The hydrology of the Truckee River System, Nevada and California, was examined defining the inputs, the hydrologic interactions, and the outputs from the system. Techniques for streamflow data synthesis were examined to determine which of the several methods available was best suited to the multiple-site study. The hydrologic model together with the synthetic flows generated provided a simulation model of the system which was combined with an optimization technique for optimal policy determination. This method of combining the hydrology of the system, streamflow synthesis, and an optimization technique is valid and valuable. (Knapp-USGS)
W71-05042

ANALYSIS OF RESERVOIR YIELD,
Missouri Univ., Columbia. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W71-05081

SYSTEMS ANALYSIS, A SUBSTITUTE FOR PLANNING,
California Univ., Los Angeles.
John A. Dracup.
In: Evaluation Processes in Water Resources Planning, Urbana, Illinois, American Water Resources Association, p 26-40, July 1970.

Descriptors: *Systems analysis, Water resource planning, Optimization, Decision-making, Cost-benefit analysis, Uncertainty, Waste water collection, Economic efficiency.
Identifiers: *Multiple objective planning, Social welfare function, Transformation curve, Objective function, Decision theory.

The role of systems analysis in water resource planning is considered. The paper discusses the application of systems techniques to the measurement of benefits from multiple objective water resource projects. The example of the Great Lakes is given to illustrate the use of systems analysis as a multilevel-multilayer approach to a complex system. This systems model represents the ecological, physical, biological, processes as well as the economic, social, and political aspects of the Great Lakes problem. The problem of uncertainty can be incorporated into the analysis through applied decision theory. Since this example involves multipe objective functions, there is no unique solution but a set of efficient solutions exists. Systems analysis provides the decision-maker or planner with recommended policies and possible alternatives when the dynamics of the system changes. The use of systems techniques has been limited with respect to waste water collection and treatment system design. The author concludes that while research in water resource system field is advanced, its impact on water resource planning remains limited. (Siegenthaler-Rutgers)
W71-05221

PROGRAM BUDGET FOR NATURAL RESOURCES ACTIVITIES,
Werner Z. Hirach.
In: Program Budgeting, Cambridge, Harvard University Press, 1967, p 248-282.

Descriptors: *Natural resources development, *Government, *Budgets, Economic evaluation, Receation, Decision-making, Time, Costs, Investment, Research, Land, Cost-benefit analysis, Air pollution, Demand, Risk.
Identifiers: *Program budget, *Economic growth, Santa Maria project, Alternatives.

The judicious development and management of natural resources is hampered by the lack of a carefully defined national resources policy. Thus, this paper examines some assumptions and objectives of our natural resources policy and how it effects the economic performance of the country. The manner in which natural resources activities are treated in the existing scheme is reviewed and steps are considered which would bring it closer to becoming a program budget. The author then presents examples of how program budgeting can elucidate allocation decisions. In the concluding section, the administrative and institutional arrangements needed to implementation allocation decisions in the natural resources field are considered. The paper, although concerned with the entire field of natural resources uses examples and techniques relevant to water resources study. (Murphy-Rutgers)
W71-05232

LINEAR PROGRAMMING MODELS FOR WATER POLLUTION CONTROL,
Cornell Univ., Ithaca, N.Y.
For primary bibliographic entry see Field 05G.
W71-05236

ANALYSIS OF PROJECTS FOR ECONOMIC GROWTH,
Project Development, Inc., Washington, D.C.
For primary bibliographic entry see Field 06B.
W71-05238

A NOTE ON THE APPLICATION OF LINEAR PROGRAMMING TO CAPITAL BUDGETING,
British Columbia Univ., Vancouver.
Peter Lusztig, and Berhard Schwab.
Journal of Financial and Quantitative Analysis, Vol 3, No 5, p 427-431, December 1968.

Descriptors: *Linear programming, Discount rate, Decision-making.
Identifiers: *Capital budgeting, Objective function, Opportunity cost, Sensitivity analysis, Internal rate of return, Present value.

A linear programming model is presented of a capital budgeting decision. Once the discount rate is chosen, the present value of the investment project is determined and the linear programming model can be solved. However, the application of linear programming techniques to capital budgeting implies a mutual dependence between the optimal solution of the programming model and the discount rate used in the calculation of the objective function coefficients. This problem has been ignored in previous research with few exceptions. As a solution to this problem, the authors propose a sensitivity analysis of the optimal solution with regard to changes in the coefficients of the objective function. The present value of the prospective project is recomputed and the sensitivity analysis is used to determine whether the optimal solution still is valid. This method enables the decision maker to ascertain whether the original solution obtained via linear programming is subject to revision. This article is relevant for research projects concerned with the application of capital budgeting concepts to water resource planning. (Siegenthaler-Rutgers)
W71-05244

A SYSTEMS STUDY OF SOFT GROUND TUNNELING,
Fenix and Scisson, Inc., Tulsa, Okla; and Little (Arthur D.) Inc., Cambridge, Mass.
For primary bibliographic entry see Field 08A.
W71-05255

OPTIMIZATION OF A SINGLE EFFECT MULTI-STAGE FLASH DISTILLATION DESALINATION SYSTEM,
Illinois Univ., Urbana. Coordinated Science Lab.
For primary bibliographic entry see Field 03A.
W71-05256

6B. Evaluation Process

WILD RIVERS -- METHODS FOR EVALUATION,
Water Resources Engineers, Inc., Walnut Creek, Calif.
Michael B. Sonnen, Larry C. Davis, William R. Norton, and Gerald T. Orlob.
Available from NTIS as PB-197 729, $3.00 in paper copy, $0.95 in microfiche. Completion Report, October 1970. 106 p, 18 fig, 13 tab, 45 ref. OWRR Project C-1447 (No 198C) (1).

Descriptors: *Wild rivers, *Cost-benefit analysis, *Intangible benefits, *River basin development, Methodology, Social values, Aesthetics, Monetary benefits, Project planning, Optimum development plans, Recreation, Costs, Washington, *Evaluation.
Identifiers: *Scale of development, *Nonmonetary benefits, *Skagit River basin, Sauk-Suiattle River basin, Subjective decisions.

Two methods were developed to include intangible, nonmonetary benefit valuations within traditional cost-benefit analyses. Each method was demonstrated for the Upper Skagit River Basin (a currently developed basin) and for the Sauk-Suiattle River Basin (a currently wild river), two adjacent basins in the State of Washington. The Benefits Foregone--Subjective Decision Method requires (1) estimates of monetary benefits for proposed levels of basin development (including the river left wild as one alternative), (2) values for two coefficients in a parabolic equation expressing change of intangible, nonmonetary benefits with increased development, and (3) comparison of total benefits to costs (evaluated independently) to indicate the optimum development level. The Nonmonetary Expression of Benefits Method requires monetary benefits and costs just as in the first method, but nonmonetary benefits are calculated as percentages (up to 1000%) of the identifiable monetary benefits. These percentages are derived from multipliers supplied for each potential water use group or development purpose. The demonstrations for each method indicated that the Sauk-Suiattle River should be left wild, while the Skagit River should be even more fully developed. The research showed that meaningful intangible benefit evaluation is not particularly difficult.
W71-04930

PERCEPTION OF WATER RESOURCE INFORMATION SOURCES AND EDUCATIONAL NEEDS BY LOCAL OFFICIALS AND SPECIAL INTEREST GROUPS,
North Carolina State Univ., Raleigh. Dept. of Adult and Community Coll. Education; and North Carolina Water Resources Research Inst., Raleigh.
James M. Stewart, and David H. Howells.
Available from NTIS as PB-197 730, $3.00 in paper copy, $0.95 in microfiche. North Carolina Water Resources Research Institute, Report No. 47, January 1971. 27 p, append. OWRR Project A-046-NC (2).

Descriptors: *Social participation, *Decision making, Water pollution, *Local governments, North Carolina, Social aspects, Education.
Identifiers: Public participation, *Public education, Water resources information, *Public information.

The study is a phase of a more comprehensive research effort on communication and educational techniques in water resource management and deals with perception of water resource information sources and educational needs at the local level. Includes chairmen of County Boards of Commissioners, City Managers, Officers of League of Women Voters, Presidents of County Wildlife Clubs, Soil and Water Conservation District Supervisors, County Extension Chairmen, and Executive Committee of Conservation Council of North Carolina. Results show marked deficiencies in public information and education dealing with water resources and will be useful to water resource agencies in assessment and planning of public information and education programs. (HowellsNorth Carolina)
W71-04933

FACTORS INFLUENCING THE RESIDENTIAL UTILIZATION OF RESERVOIR SHORELANDS IN THE SOUTHEAST,
North Carolina Univ., Chapel Hill. Center for Urban and Regional Studies; and North Carolina Water Resources Research Inst., Raleigh.
Raymond J. Burby, III, Thomas G. Donnelly, and Shirley F. Weiss.
Available from NTIS as PB-197 731, $3.00 in paper copy, $0.95 in microfiche. North Carolina Water Resources Research Institute, Report No 44, December 1970. 50 p, 8 tab, 9 ref, 4 append. OWRR Project B-012-NC (6).

Descriptors: *Reservoirs, Reservoir sites, Reservoir construction, Land development, *Land use, Land ownership, Land management, Watershed management, North Carolina, Water utilization, *Recreation, *Multiple-purpose reservoirs, Recreation facilities, *Social aspects, Local governments.
Identifiers: Land use policy.

For local governmental units to participate effectively in the provision of public recreation facilities at multipurpose reservoir projects, private recreational investment must supplement existing local fiscal resources. Recreational residential development offers one important means of achieving this end, but reservoir shoreline development tends to be unevenly distributed in the Southeast. Before residential investment prospects can be incorporated into water resource project planning, factors influencing variation in reservoir shoreline development should be identified and evaluated wherever possible. Analysis of data from 74 multipurpose reservoir projects in the Southeast indicates that the residential use of water projects is primarily a function of various aspects related to the size of a project, the number and affluence of people living nearby (within 25 miles), and the visual attractiveness of the project. Considering the extent of taxable private shoreline investment as a criterion, local provision of public recreational facilities seems to be feasible for larger reservoirs located within relatively populous and affluent jurisdictions. In the case of smaller reservoirs in low income or rural areas, local government should probably not be expected to provide such facilities, nor, it seems, should local officials expect private recreational investment at multipurpose reservoirs to provide much in the way of fiscal dividends. (Weiss-North Carolina)
W71-04934

ECONOMIC ANALYSIS OF WATER USE IN ILLINOIS AGRICULTURE,
Illinois Univ., Urbana. Dept. of Agricultural Engineering; and Illinois Univ., Urbana. Water Resources Center.
Earl R. Swanson.
Available from NTIS as PB-197 732, $3.00 in paper copy, $0.95 in microfiche. Illinois Water Resources Center Research Report No 38, January 1971. 59 p, 19 tab, 8 ref. OWRR Project B-014-Ill (6).

Descriptors: *Irrigation, Linear programming, *Dynamic programming, Crop response, Farm management, *Regression analysis, Soil moisture, *Cost analysis, *Corn (Field), *Evaluation, Illinois, Irrigation efficiency.
Identifiers: Economic analysis.

Approximately 28,000 acres of field and specialty crops were irrigated in Illinois in 1966. Supplemental irrigation of corn accounted for over one half of this acreage. Important elements in the decision to invest in irrigation equipment for corn include the expected effect of irrigation on year-to-year fluctuations in income and on average income. Regression models were used to estimate the influence of moisture variable on corn yield. A moderate gain in expected income from corn was obtained by employing the irrigation policy dictated by dynamic programming rather than the policy from a moisture-deficit model. In addition to the economic analysis of the irrigation of corn viewed as a single crop, it was necessary to examine its role in the context of the total farm business. The competitive position of corn in the rotation was evaluated. Labor distribution was an important factor in determining an optimal cropping pattern. General rules were developed for adjusting leases on rented farms to provide economic incentives for both landlord and tenant to adopt supplemental irrigation. The results of all of the analyses would have been substantially improved with crop-response data from experiments in which the range of variation of water and complentary cultural practices included economically optimal levels of these inputs. (Swanson-Illinois)
W71-04935

WATER SUPPLY MANAGEMENT PLAN FOR MUSKEGON COUNTY,
Muskegon County Metropolitan Planning Commission, Mich.; and Bauer Engineering, Inc., Chicago, Ill.

Available fron NTIS as PB-195 769, $3.00 in paper copy, $0.95 in microfiche. Muskegon County Metropolitan Planning Commission Report, Dec 1969. 101 p. HUD Project No P-295.
Identifiers: *Regional planning, Michigan, *Water supply, Regional planning, Management planning, Groundwater, Surface water runoff, Industries, Re-

sidential buildings, Recreation, Water conservation, Statistical data, Cost estimates, Maps, *Muskegon County, Michigan.

The intent of this report is to provide a framework for a coordinated, guided, and planned management of water supply systems in Muskegon County. As a basis for this framework, an inventory of present water quality, quantity, location, and usage is provided. All sources of water, groundwater, inland surface water, and Lake Michigan water, are considered. Residential, commercial, and industrial water usage are discussed. Public attitudes toward water supply have been surveyed and are reported. A management strategy (a process-oriented version of a plan) is proposed. Here major issues in water supply management; namely: (1) the formulation of a coordinating body; (2) the expansion of public supply service areas; (3) water for recreation; and (4) water conservation are discussed in reference to the development of a country-wide approach to water supply.
W71-04945

RECREATION AND THE LOCAL ECONOMY - AN INPUT-OUTPUT MODEL OF A RECREATION-ORIENTED ECONOMY,
Wisconsin Univ., Madison. Graduate School of Business Administration.
William A. Strang.
Available from NTIS as PB-195 744, $3.00 in paper copy, $0.95 in microfiche. Sea Grant Technical Report No 4, WIS-SG-71-204, Oct 1970. 68 p, 2 fig, 14 tab, 52 ref. NSF Grant GH-102.
Identifiers: *Economic development, *Wisconsin, *Recreational facilities, *Lakes, Regional planning, Industrial management, Water quality, Mathematical models, Cash flow, Water resources, Statistical data, Sea Grant program, Recreation oriented economics, Green Bay (Wisconsin), Door County (Wisconsin), Tourism, Input output models.

The scope was broadened of a marine research program conducted in Green Bay, a major bay of Lake Michigan. The findings are presented of the first stage of a 3-stage project to relate water quality to the economic health of an area oriented toward outdoor recreation. The 3 project stages are: (1) Identify the economic interactions in the area and trace the total impact of tourism on the economy; (2) measure the direct and indirect economic impacts of specific groups of tourists on the local economy; and (3) relate the several dimensions of the quality of local water resources to the number of tourists drawn to the area in these specific groups. It will then be possible to relate water quality to an important segment of the local economy.
W71-04955

CONSERVATION, CONTROL, AND USE OF WATER RESOURCES OF THE MISSOURI RIVER BASIN.
Department of the Interior, Washington, D.C.
For primary bibliographic entry see Field 06E.
W71-04986

A SUMMARY OF MASSACHUSETTS STATE LAWS, POLICIES AND PROGRAMS PERTAINING TO WATER AND RELATED LAND RESOURCES.
Massachusetts Water Resources Commission, Boston. Div. of Water Resources.
For primary bibliographic entry see Field 06E.
W71-04996

WATER RESOURCES PLANNING SEMINAR,
Florida State Board of Conservation, Tallahassee. Div. of Water Resources and Conservation.
Charles Appel, George T. Baragona, Woody Beeman, E. W. Bishop, and Mickey D. Bryant.
March 1968. 161 p, 1 fig, 5 chart, 1 append.

Descriptors: *Florida, *Water resources development, *Planning, *Training, Administration, Administrative agencies, Water resources, Natural resources, Conservation, River basin development, Water law, Legal aspects, Water policy, Watershed management, Hydrological aspects, Water pollution control, Geologic investigations, Economic justification, Water demand, Water supply, Surface waters, Public health, Recreation demand, Personnel, Leadership.

To provide staff personnel with a basic, overall view of the technical, administrative, and legal problems and terminology of water resources study and planning, the Florida Board of Conservation, Division of Water Resources and Conservation sponsored a training seminar in water resource planning. This report summarizes the six sessions of the seminar and makes recommendations concerning future seminars. An appendix consists of the texts of individual speakers' presentations on: (1) geography, (2) water resources, (3) lake hydrology, (4) surface water hydrology, (5) chemical quality of water in Florida, (6) history of river basin planning, (7) geology and water resources planning, (8) U.S. Department of Agriculture agency roles in river basin planning, (9) economic development and projections in river basin planning, (10) U.S. Forest Service responsibilities in river basin planning, (11) economic planning by soil conservation service in river basin planning, (12) hydraulic engineering, (13) geology of Florida, (14) physiography of Florida, (15) sink holes, (16) water resources problems, (17) municipal water use, (18) industrial use, (19) water resources project evaluation for fish and wildlife resources, (20) water law in Florida, (21) air and water pollution control commission, (22) State Board of Health activities, and (23) planning for public resources based on outdoor recreation. (Liptak-Florida)
W71-04997

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 2, SECTION B-HYDROLOGY,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W71-05037

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 4, SECTION E - COST FUNCTIONS FOR INFLUENCING WATER QUALITY; SECTION F - RELATION OF PARTICIPATION IN OUTDOOR RECREATION AND PUBLIC ATTITUDES TOWARD WATER QUALITY,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W71-05038

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 5, SECTION G - SYSTEMS ANALYSIS OF HYDROPOWER PRODUCTION ON THE WISCONSIN RIVER,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W71-05039

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 9, SECTION K - AN ANALYSIS OF ALTERNATIVE INSTITUTIONAL PATTERNS FOR MANGING WATER QUALITY ON A REGIONAL SYSTEM BASIS,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W71-05041

FIFTEENTH ANNUAL WATER CONFERENCE.
New Mexico State Univ., University Park. Water Resources Research Inst.
For primary bibliographic entry see Field 04B.
W71-05065

PUBLIC OPPOSITION TO NUCLEAR POWER - AN INDUSTRY OVERVIEW,
Atomic Industrial Forum, Inc., New York; and Niagra Mohawk Power Corp., Syracuse, N.Y.
For primary bibliographic entry see Field 05C.
W71-05126

ENGINEERING SAFETY FACTORS AND THEIR INFLUENCE ON SITING PRACTICES FOR NUCLEAR POWER PLANTS IN THE EUROPEAN COMMUNITIES,
Council of the European Communities, Brussels (Belgium). Industrial Affairs.
For primary bibliographic entry see Field 05C.
W71-05129

SOIL AND WATER CONSERVATION NEEDS INVENTORY, COOKE, GRAYSON AND FANNIN COUNTIES, TEXAS.
Texoma Regional Planning Commission, Tex.
For primary bibliographic entry see Field 03F.
W71-05150

WATER RESOURCES COUNCIL; POLICIES AND PROCEDURES IN PLAN FORMULATION AND EVALUATION OF WATER AND RELATED LAND RESOURCES PROJECTS.
Water Resources Council, Washington, D.C.
For primary bibliographic entry see Field 06C.
W71-05187

WATER PROJECTS -- A CHANGING PERSPECTIVE,
Sierra Club, San Francisco, Calif.
Michael McCloskey.
Sierra Club Bulletin, Vol 55, No 7, p 8-11, July 1970.

Descriptors: *Project feasibility, *Economic justification, *Evaluation, *Water resources development, *Federal project policy, Water management (Applied), Political aspects, Water policy, Federal government, Water Quality Act, History, Social aspects, Social needs, Water conservation, Legislation, California, Arizona, Arkansas, Projects, Wild River Act, Benefits, Hydroelectric power.
Identifiers: *Central Arizona Project.

Most of the politically and economically desirable water projects have been built largely in the western U.S. In earlier periods, public policy gave benefit of the doubt to the case for construction of water projects. However, conditions which may once have justified this approach have changed radically. Nevertheless, that past great period of water project development has generated powerful federal agencies having vested interests in continuing these activities, even though diminishing returns may be accruing in terms of total public values stemming from further projects. Current goals of the Federal Power Commission, Corps of Engineers and Bureau of Reclamation are reviewed and discussed. It is argued that tradition and interests of special clienteles are too often dictating irrelevant, or uneconomic projects and the use of obsolete methods. An example is the Central Arizona Project, which will create an artifical agricultural demand which would not exist in the absence of a heavy water cost subsidy. There are 3 basic aspects of water project evaluation: engineering, economics and intangibles. Engineering aspects could be handled by the construction agency but the other 2 aspects should be handled by separate evaluating agencies. Congressional evaluation and legislation of agency proposals is also in great need of modernization. (Casey - Arizona)
W71-05195

WATER QUALITY, THE STATE OF THE ART,
Wayne State Univ., Detroit, Mich.
For primary bibliographic entry see Field 05G.
W71-05212

SOFT WATER SUPPLY FOR URBAN CONSUMPTION, A FEASIBILITY STUDY,
Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 04B.
W71-05215

WATER RESOURCE MANAGEMENT IN ARID ENVIRONS,
Resources for the Future, Washington, D.C.; and Iowa State Univ., Ames.
For primary bibliographic entry see Field 04B.
W71-05216

SYSTEMS ANALYSIS, A SUBSTITUTE FOR PLANNING,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06A.
W71-05221

MULTIPLE OBJECTIVE PLANNING, BENEFIT-COST ANALYSIS AND DISCOUNT RATE,
Water Resources Council, Washington, D.C.
Gary D. Cobb.
In: Evaluation Processes in Water Resources Planning, Urbana, Illinois, American Water Resources Association, p 101-118, July 1970.

Descriptors: *Cost benefit analysis, Discount rate, Economic evaluation, Decision-making, Interest rate, Economic efficiency.
Identifiers: *Multiple objective planning, Regional development, Social rate of discount, Transformation curve, Public investment, Opportunity cost, Shadow price.

The work of the special taskforce of the Water Resources Council on evaluation practices used in Federal water resource projects is reviewed. Benefits and costs are defined in terms of the objectives of national income growth, social well-being, regional development and enhancement of environmental quality. The planning process for use of water resources includes the formulation of alternatives in order that tradeoffs among plans can be identified. The approach selected is multiobjective with the aim of the project design to choose the point of highest social value or, if using weights, the highest cost-benefit ratio. Problems connected with cost-benefit analysis are discussed including interest rate standards, secondary benefits, pricing problems and weighting. The author concludes that a major impediment is the divergent views on the meaning of cost-benefit analysis among planners. The author recommends that planners should discount both public and private projects at the social rate of discount for benefit-cost calculations. (Siegenthaler-Rutgers)
W71-05224

SPECIAL PROBLEMS OF METROPOLITAN WATER RESOURCES ANALYSIS,
Chicago Univ., Ill.
John R. Sheaffer.
In: Evaluation Processes in Water Resources Planning, Urbana, Illinois, American Water Resources Association, p 75-90, July 1970.

Descriptors: *Water resources management, *Multiple-purpose projects, Water quality, Cost-benefit analysis, Decision-making, Waste water treatment, Simulation analysis, Political constraints.
Identifiers: *Metropolitan planning, Complex management strategy, Iterative process.

Metropolitan water resource management is considered to be a subsystem of the total urban system. The author identifies a number of concepts of metropolitan water resource management including multiple purpose planning, public and private decision-making on water resources projects and political constraints on policy making. The example of Waterloo, Iowa is used to demonstrate the weakness of single purpose strategies for water resource planning. The complex management strategy is introduced as an alternative approach with the use of water as an organizing concept. The organizing concept discourages single-purpose strategies and provides a means for channeling the information required for an optimal solution. The Muskegon County waste water management plan is used to present methodology for the implementation of new technology in a metropolitan area. This plan recognized the need for broad unified goals and facilities plus community involvement and education. A model of waste water irrigation is also presented to illustrate the use of computer simulation in the complex management strategy. Stress is given to the need for research concerning the adaptation of models and planning processes to the metropolitan region. (Siegenthaler-Rutger)
W71-05225

POLITICAL AND INSTITUTIONAL ASPECTS OF THE EVALUATION OF WATER RESOURCES PROGRAMS,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 06E.
W71-05226

THE DEFINITION AND MEASUREMENT OF DROUGHT LOSSES: THE NORTHEAST DROUGHT OF 1962-1966,
Resources for the Future, Washington, D.C.
For primary bibliographic entry see Field 06C.
W71-05233

ANALYSIS OF PROJECTS FOR ECONOMIC GROWTH,
Project Development, Inc., Washington, D.C.
Morris J. Solomon.
New York, Praeger, 1970. 498 p.

Descriptors: *Decision-making, Benefit-cost analysis, Economic evaluation, Discount rate.
Identifiers: *Project analysis, Economic growth, Payback period, Opportunity cost, Sensitivity analysis, Present value, Time horizon.

A framework is presented for project analysis that can be used to evaluate alternative projects in addition to the primary project. The framework specifies the data required, the format to be used, and the criteria to apply to the evaluation of alternatives. The process of decision-making is described in terms of a planning-action feedback cycle. The fundamentals of time phasing and discounting are described with their use as tools for project evaluation outlined. Economic yardsticks such as national gross rate of return and surplus rate of return are proposed to serve as indicators of the attractiveness of a project from an economic growth point of view as well as the impact on particular groups in the economy. The problems of interdependence among projects and uncertainty are discussed with procedures for dealing with each problem illustrated. This book is relevant for water administrators concerned with the formulation, evaluation, and implementation of water resource projects. (Siegenthaler-Rutgers)
W71-05238

REVELATION OF PREFERENCE FOR A PUBLIC GOOD WITH IMPERFECT EXCLUSION,
Northwestern Univ., Evanston, Ill.
Morton I. Kamien, and Nancy L. Schwartz.
Public Choice, Vol IX, p 19-30, Fall, 1970.

Descriptors: *Economic evaluation, *Government, *Resource allocation, Economic efficiency, Model study, Prices, Optimization, Social aspects, Probability, Maximization, Demand.
Identifiers: *Public goods, *Utility, *Preference function, *Exclusion, *User charges.

The model presented is designed to explain the behavior of an individual in revealing his preferences regarding goods which do not permit perfect exclusion. This is particularly relevant to the case of water resources recreation in which the authors' explanation of user charges is most applicable. It is shown that a bid of zero will be made if the public good does not increase his total utility at a zero price or if the probability of being able to consume the good without payment is sufficiently large. The paper derives the difference between the maximum the individual would be willing to pay rather than do without and the optimal amount he would bid in the presence of imperfect exclusion. The individual almost always understates some of his preference for the good but it is shown that the individual's offer increases, and hence moves in the direction of his true preference, as the degree of exclusion increases. This article is relevant for establishing cost justifications with respect to many of the environmental amentities associated with water investment projects. (Murphy-Rutgers)
W71-05239

CHOICE OF TECHNIQUE IN THE PUBLIC SECTOR: A SIMPLIFICATION,
Harvard Univ., Cambridge, Mass.
Martin S. Feldstein.
The Economic Journal, Vol LXXX, No 320, p 985-989, December 1970.

Descriptors: *Benefits, *Costs, *Discount rate, *Economic evaluation, *Government, Time, Capital, Investment, Social aspects, Economic efficiency, Optimization, Taxes, Mathematical study.
Identifiers: *Social time preference, *Social rate of return, *Opportunity costs.

The aggregation of the benefits and costs of public water resource investments raises the problem of incorporating both the normative social time preference discount rate and the social rate of return on private investment. This paper attempts to show that in an important special class of public-expenditure decisions the problem of evaluating the social opportunity cost of funds transferred from the private sector can be ignored and only the social time preference rate is important. Thus, the paper is relevant for the evaluation of water resource investments. The author also argues against the suggestion that all public expenditure proposals be evaluated only at the social time preference rate with no regard for the social opportunity costs of the funds transferred from the private sector. (Murphy-Rutgers)
W71-05240

THE EVALUATION OF RISKY INTERRELATED INVESTMENTS,
Stanford Univ., Calif.
For primary bibliographic entry see Field 06C.
W71-05241

THE INDUSTRIAL POINT OF VIEW,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 05G.
W71-05242

WATER QUALITY AND MAN'S ENVIRONMENT,
Federal Water Pollution Control Administration, Kansas City, Mo.
For primary bibliographic entry see Field 05G.
W71-05243

SOCIAL SCIENCES AND THE ENVIRONMENT,
Colorado Univ., Boulder, and Environmental Science Services Administration, Washington, D.C.
Morris E. Garnsey, and James R. Hibbs.
Boulder, University of Colorado Press, 1967. 249 p.

Descriptors: *Environment, Cost-benefit analysis, Program budgeting, Decision making, Economic evaluation.
Identifiers: *Public good, Social benefit, Social cost.

The papers were presented at the Conference on the Present and Potential Contribution of the Social Sciences to Research and Policy Formulation in the Quality of the Physical Environment in 1967. They were cross-disciplinary and are illustrations of contributions of several disciplines to research in the quality of the physical environment. The subjects considered included ecology, program budgeting, public goods valuation and a multi-disciplinary attack on water pollution. The use of cost-benefit analysis in public decision-making was discussed along with the empirical problems of calculations. The treatment of such topics as public goods, cost benefit analysis and water pollution problems makes this bookof general relevance to water studies. (See also W71-05246) (Siegenthaler-Rutgers)
W71-05245

ECONOMICS AND THE QUALITY OF THE ENVIRONMENT, SOME EMPIRICAL EXPERIENCES,
Resources for the Future, Washington, D.C.
Allen V. Kneese.
In: Social Sciences and the Environment, Boulder, University of Colorado Press, 1967, p 165-182.

Descriptors: *Cost-benefit analysis, Probability, Economic evaluation, Resource allocation, Mathematical model, Flood control.
Identifiers: *Willingness to pay, Public good, Externalities, Social benefit.

Experiences and problems of estimating the benefits of environmental improvement are discussed. With respect to benefit evaluation, the economists' conceptual framework uses prices as indicators of social value or benefits. Where market failure occurs, certain market prices together with assumptions about human preferences and behavior care are used in the valuation process. An example of this imputation procedure is the determination of flood control benefits where the measurement of the benefit can be taken as the avoidance of the loss. The author discusses the willingness to pay for improved water quality from the point of view of municipal and industrial users and recreational use. Research indicates that the benefits of improved water quality to municipal and industrial users do not justify the incremental costs. With respect to recreational use, the total value attached to recreational resources is a function of the number of people who have access and the availability of alternatives. The author stresses the need for further research on the benefits of water improvement for recreational demand. (See also W71-05245) (Siegenthaler-Rutgers)
W71-05246

PLANNING-PROGRAMMING-BUDGETING: A SYSTEMS APPROACH TO MANAGEMENT,
Washington Univ., Seattle.
Fremont J. Lyden, and Ernest J. Miller.
Chicago, Markham Publishing Company, 1967. 443 p.

Descriptors: *Systems analysis, Economic evaluation, Cost-benefit analysis, Decision-making, Economic efficiency, Risk, Program budgeting.
Identifiers: *Planning-Programming, Budgeting, Cost utility analysis.

This book presents a collection of readings that provide an understanding of Planning-Programming-Budgeting (PPB) and its implications in managerial as well as policy contexts. PPB places emphasis upon program results and analytical techniques and thus affects public management. The essays consider what the PPB approach to management is, its stages of development, the relationship of PPB to other kinds of budgeting approaches, and its limitations and deficiencies. This book is relevant to water studies concerned with the application of new budgeting approaches to program evaluation and project selection. (See also W71-05248) (Siegenthaler-Rutgers)
W71-05247

TOWARD A THEORY OF BUDGETING,
International Atomic Energy Commission, New York.
Verne B. Lewis.
In: Planning-Programming-Budgeting: A Systems Approach to Management, Chicago, Markham Publishing, 1967, p 117-139.

Descriptors: *Budget estimation, Marginal utility, Incremental analysis, Economic evaluation, Cost-benefit analysis, Forecasting.
Identifiers: *Public expenditure budgeting, Alternative budgeting, Open-end budgeting, Unit costing, Fixed-ceiling method, Opportunity cost.

Analyzes were made of propositions derived from economic theory which are applicable to public budgeting and can serve as the basis for an economic theory of budgeting. The economic aim of budgeting is to achieve the efficient use of resources. To meet this aim, the benefits derived from any expenditure must be worth their cost in terms of sacrificed or displaced alternatives. Incremental analysis at the margin is applied to concentrate attention on resources which yield the higher return. These values can be compared by determining their relative effectiveness in achieving a common purpose. The author suggests the alternative budget procedures as a method of budget analysis. Its purpose is to pose budget questions in terms of relative value at every level of decision making. Under alternative budgeting, officials would present both a basic budget estimate and plans for alternative amounts near the margin. A comparison of alternative budgeting is made with existing budgeting techniques. This article is relevant for water research concerned with the budgeting control of water resource programs. (See also W71-05247) (Siegenthaler-Rutgers)
W71-05248

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COST OF PUMPING IRRIGATION WATER IN ARIZONA: 1891 TO 1967,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 03F.
W71-04851

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 4, SECTION E - COST FUNCTIONS FOR INFLUENCING WATER QUALITY; SECTION F - RELATION OF PARTICIPATION IN OUTDOOR RECREATION AND PUBLIC ATTITUDES TOWARD WATER QUALITY,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W71-05038

WATER RESOURCES COUNCIL; POLICIES AND PROCEDURES IN PLAN FORMULATION AND EVALUATION OF WATER AND RELATED LAND RESOURCES PROJECTS.
Water Resources Council, Washington, D.C.

Federal Register, Vol 35, No 143, Friday, July 24, 1970, p 11969-11970.

Descriptors: *Discount rate, *Cost-benefit analysis, *Federal-project policy, *Interest rate, Water resources, Administration, Decision making, Water resources development, Federal government, Cost analysis, Cost allocation, Cost repayment, Economics, Appraisals, Project planning, Cost trends, Variable costs, Administrative agencies, Financial analysis, Regulation, Resource development, Economic efficiency, Economic justification, Economic prediction, Institutional constraints.
Identifiers: *Water Resources Council.

Provided in this administrative regulation is notice of a 5 1/8% interest rate to be applied by all federal agencies in the formulation and evaluation of water and related land resource plans. The new rate, set forth by the Water Resources Council, is effective July 1, 1970 through June 30, 1971. This rate is to be applied in discounting future benefits and computing costs in all federal and federally assisted water-resource projects. (Earl-Florida)
W71-05187

TERMINAL VALUE OR PRESENT VALUE IN CAPITAL BUDGETING PROGRAMS,
Michigan Univ., Ann Arbor.
William H. Jean.
Journal of Financial and Quantitative Analysis, Vol VI, No 1, p 649-651, January 1971.

Descriptors: *Linear programming, Marginal cost, Constraints, Interest rate.
Identifiers: *Capital budgeting, Terminal value, Present value, Sensitivity analysis, Objective function, Cashflow, Shadow price.

A model is presented to deal with a linear programming capital budgeting problem where project selection is based on the criterion of present value. The basic constraints of the linear programming model are defined and modified to allow for investment of excess cash inflows and borrowing. When the separate borrowing and lending rates are equal, maximization of the terminal value of the objective function will also maximize the present value of the projects. Thus, the present value model is a special case of the terminal value model. Imputed interest rates can be derived as well as the marginal rates of returns on capital budgets. This article is of relevance to water research concerned with project budgeting and evaluation. (Siegenthaler-Rutgers)
W71-05222

MULTIPLE OBJECTIVE PLANNING, BENEFIT-COST ANALYSIS AND DISCOUNT RATE,
Water Resources Council, Washington, D.C.
For primary bibliographic entry see Field 06B.
W71-05224

PROGRAM BUDGETING,
RAND Corp., Santa Monica, Calif.
David Novick.
Cambridge, Harvard U. Press, 1967. 382 p.

Descriptors: *Budgets, *Government, *Decision-making, Cost-benefit analysis, Natural resource development, Risk, Economic evaluation, Water resources, Transportation, Recreation, R and D, Economic efficiency, Costs, Resource allocation.
Identifiers: *Program budgeting, *Cost utility analysis, Health, Education, Department of Defense.

This study is concerned with program budgeting as it relates to the decision-making process and the problems of data and analysis. The book opens with a discussion of the government decision-making process and the role of budgeting. Of particular interest to the water researcher is the consideration of cost-utility analysis and other analytical techniques. The development of program budgeting in the Department of Defense is described and examples are given of ways in which this concept might be adapted to other government activities, including that of natural resources. The last section of the book deals with implementation and operation of the program budget and considers some of the potential problems and limitations. There is a discussion of the application of an operating federal program budget in terms of its usefulness to the executive branch, the legislative branch, the

states and private economists and political scientists. (Murphy,Rutgers)
W71-05229

LIMITATIONS, RISKS AND PROBLEMS,
Virginia Univ., Charlottesville; and Columbia Univ., New York.
Roland N. McKean, and Melvin Anshen.
In: Program Budgeting, Cambridge, Harvard University Press, 1967, p 285-307.

Descriptors: *Budgets, *Government, *Risk, Decision-making, Management, Social aspects, Costs, Minimization, Resource allocation, Economic efficiency, Planning, Technology, Optimization.
Identifiers: *Program budgeting, Cost-utility analysis, Bureaucracy, Central control, Relevant alternatives, Institutional problems.

Attempts are made to analyze the problems, limitations and risks of a program budget. The use of the program budget in water resources, along with the water resource example presented by the authors make this article relevant to the water researcher. Difficulties in the program budget are described as conceptual, operational and institutional. The conceptual difficulties are those encountered in designing the program budget and relating it to the decision-making requirements of the government. Operational difficulties are related to managerial implementation of the program budget. Institutional difficulties are described as those encouraged by bureaucratic or political pressures. The description and assessment of problems, limitations and risks is followed by suggestions for coping with them and minimizing their impact and significance. (Murphy-Rutgers)
W71-05230

CONCEPTUAL FRAMEWORK FOR THE PROGRAM BUDGET,
Harvard Univ., Cambridge, Mass.
Arthur Smithies.
In: Program Budgeting, Cambridge, Harvard University Press, 1967, p 24-60.

Descriptors: *Budgets, *Economic evaluation, *Government, Costs, Planning, Decision-making, Economic efficiency, Forecasting, Time, Prices, Regional analysis, Investment, Measurement, Social aspects.
Identifiers: *Programming, *Policy objectives, *Relevant alternatives, Economic scarcity.

Planning, programming and budgeting constitute the process by which objectives and resources, and the interrelations among them, are taken into account to achieve a coherent and comprehensive program of action for the government. This paper attempts to develop a framework in which this process may be carried out. A survey of the history of budgetary methods is provided and the criteria for the designation of an operation as a program is discussed. The functions of programming and budgeting are delineated and their respective purposes explained. The analysis of a program seeks to determine the effectiveness in achieving an objective and the economic efficiency with which the program is carried out. The role of economic analysis is important but cannot provide all the necessary information. The author proposes that programs be reviewed annually in a specific manner and makes a number of suggestions to improve the budgeting process. In the concluding section the paper points out the necessary staff arrangements for an effective programming-budget system. The paper provides insights into the development of more effective program budgeting in water resources development and thus is relevant to the interests of the water researcher. (Murphy-Rutgers)
W71-05231

THE DEFINITION AND MEASUREMENT OF DROUGHT LOSSES: THE NORTHEAST DROUGHT OF 1962-1966,
Resources for the Future, Washington, D.C.
Clifford S. Russell.
In: Proceedings of the Fourth American Water Resources Conference, New York, NY, November 18-22, 1968, p 623-635.

Descriptors: *Decision making, *Drought, Cost-benefit analysis, Cooling tower, Recirculated water, Economic evaluation, Discount rate.
Identifiers: *Social cost, Opportunity cost, Public investment.

A study was made of drought losses based on field work in three Massachusetts cities. Interviews were conducted with managers of industrial firms and commercial establishments in order to make an initial estimate of drought losses. The raw annual drought losses tended to be dominated by the industrial and municipal government sectors. The bulk of losses were business investment in wells, cooling towers, lost municipal revenues, and the costs of emergency water supplies. Corrections were made for the investment aspect of losses with an aggregate profit resulting from drought induced investment. Further corrections were performed for the transferral or deferral of production and unemployment. It was found per capita losses increase with the size of the water shortage with the rate of increase being smaller for the corrected estimates. This example of loss estimation is useful for the planning of water supplies in the future. (Siegenthaler-Rutgers)
W71-05233

THE EVALUATION OF RISKY INTERRELATED INVESTMENTS,
Stanford Univ., Calif.
Frederick S. Hillier.
Amsterdam, North-Holland Publishing Company, 1969. 113 p.

Descriptors: *Economic evaluation, *Risk, Linear programming, Probability distribution, Decision-making, Budget constraint.
Identifiers: *Interrelated investment, *Chance-constrained programming, Present value, Expected utility, Cash flow, Algorithm, Non-parametric statistics.

The problem of evaluating a proposed set of risky interrelated investments is studied, using present value and expected utility of present value as criteria. The author developed properties that characterize and optimal combination of investments and then formulated a model for describing interrelated investments. This model can be used for determining the mean, variance and functional form of the probability distribution of present value. An approximate linear programming and an exact branch-and-bound algorithm were developed for selecting the investment to be made. The problem was studied also from a dynamic point of view using chance-constrained programming models for maximizing present value subject to probabilistic constraints on the allowable risk. The advantage of the expected utility approach lies in its precise evaluation of investments while the chance-constrained programming approach is dynamic and easier to implement. This book is relevant to water resource studies concerned with the application of evaluation techniques to problems of capital budgeting and investment planning. (Siegenthaler-Rutgers)
W71-05241

A NOTE ON THE APPLICATION OF LINEAR PROGRAMMING TO CAPITAL BUDGETING,
British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 06A.
W71-05244

TOWARD A THEORY OF BUDGETING,
International Atomic Energy Commission, New York.
For primary bibliographic entry see Field 06B.
W71-05248

6D. Water Demand

CONSUMPTIVE IRRIGATION REQUIREMENTS FOR CROPS IN IDAHO,
Idaho Univ., Moscow. Dept. of Agricultural Engineering; and Idaho Water Resource Board.
For primary bibliographic entry see Field 03F.
W71-05201

6E. Water Law and Institutions

EDWARD BALF CO V HARTFORD ELECTRIC CO (REMEDIES FOR OBSTRUCTION OF NAVIGABLE RIVER).

138 A 122-127 (Conn 1927).

Descriptors: *Connecticut, *Navigable waters, *Navigation, *Remedies, Damages, Conduits, Construction, Riparian land, Riparian rights, Channels, Dredging, Bridges, Federal government, Banks, Water levels, Navigable rivers, Administrative agencies, Legal aspects, Judicial decisions, Adjudication procedure.

Plaintiff roadbuilding company sought an injunction to restrain defendant electric company from maintaining a conduit over a river, thereby obstructing navigation and preventing plaintiff from transporting materials by boat to its land. Defendant contended that the river was not navigable and that therefore such an action could not be maintained. The trial court found: (1) that the river was navigable, (2) that defendant's conduit obstructed navigation, but (3) that the conduit constituted a public nuisance and plaintiff did not show an injury distinct from others. Both parties appealed and the Connecticut Supreme Court of Errors affirmed. Evidence showed that the stream was navigable. The federal government exercised jurisdiction over it as a navigable stream. A river is navigable when it is used or is susceptible of use in its natural and ordinary condition as a highway for commerce. The fact that this river had not been used recently by boats and would need some dredging did not render it non-navigable. Plaintiff's evidence did not show substantial, serious, or actual damage. The fact that plaintiff was deprived of access to its land by water was not conclusive of a special injury to its business. (Duss-Florida)
W71-04961

FEDERAL PROTECTION OF ENDANGERED WILDLIFE SPECIES,
William S. Boyd.
Stanford Law Review, Vol 22, No 6, p 1289-1309, June 1970. 21 p, 138 ref.

Descriptors: *Wildlife, *Wildlife conservation, *Wildlife management, *Federal government, State governments, Legislation, Legal aspects, Judicial decisions, Administration, Environment, Ecology, Environmental effects, Regulation, Standards, Hunting, Fishing, Animal behavior, Migratory birds, Waterfowl, Fish, Conservation, Nesting, Breeding, Federal jurisdiction, State jurisdiction, United States.

Advocating increased federal protection of endangered wildlife species, this note considers the constitutional aspects of the issue and suggests possible directions for federal regulation. Traditionally states have exercised primary responsibility for wildlife protection; however, state efforts have been largely ineffective. Heretofore, the federal government's contribution in the area has been minimal. Opponents of federal legislation have argued that: (1) the issue was decided against the government in the Supreme Court decision of Missouri v. Holland; (2) there is no enumerated provision in the Constitution permitting the government to enact such legislation; and (3) the states are sole owners of wildlife within their borders, and such ownership

precludes federal interference. This note argues that: (1) Missouri v. Holland did not preclude federal legislation for wildlife protection, (2) the territorial power or commerce clause in the Constitution could serve as a basis for legislation, and (3) the doctrine of state ownership of wildlife has been ineffective where it has conflicted with federal interests. Exclusive federal control over wildlife is not needed, but legislation should empower appropriate federal departments to promulgate necessary regulations and encourage states to adopt effective programs for wildlife protection. At any rate, exclusive jurisdiction should not be left to the states. (Duss-Florida)
W71-04982

OIL POLLUTION DAMAGE TO NAVIGABLE WATERS AND MARINE LIFE GIVES RISE TO MARITIME LIEN WHICH WILL SUPPORT ADMIRALTY ACTION IN REM.
Journal of Maritime Law and Commerce, Vol 2, No 1, p 200-202, Oct 1970. 3 p, 9 ref.

Descriptors: *Federal jurisdiction, *Admiralty, *Ships, *Water pollution control, Pollution abatement, Pollutants, Water pollution sources, Water pollution effects, Federal government, State governments, Public benefits, Navigable waters, Sea water, Marine animals, Marine plants, Public rights, Damages, Impaired water quality, Administrative agencies, Environmental effects, Cost repayment, Legal aspects, Judicial decisions, Legislation, California.
Identifiers: Oil pollution.

This comment summarizes Department of Fish and Game v. Bournemouth, 307 F. Supp. 922 (C.D. Cal 1969), a decision of a United States district court holding defendant ship amenable to a maritime lien supporting an in rem admiralty action for the costs of abatement and damages arising from oil pollution of navigable waters of plaintiff state of California. The court held that the Admiralty Extension Act of 1964 did not give rise to a lien against the defendant. However, the court determined that under principles of general maritime law, it had jurisdiction to impose a lien against the defendant. Noting that the injury in question was to the water itself and that maritime liens generally arise from collisions or personal injuries, the court held that efforts to distinguish between various types of property would be useless. The court noted that, in light of the growing incidence of oil pollution of navigable waters by ships, the public interest is best protected by the imposition of maritime liens against the offending vessel. (Earl-Florida)
W71-04983

THE ECUADOR FISHERIES DISPUTE (A NEW APPROACH TO AN OLD PROBLEM),
Daniel C. Lecuona.
Journal of Maritime Law and Commerce, Vol 2, No 1, p 91-114, Oct 1970. 24 p, 137 ref.

Descriptors: *International law, *Marine fisheries, *Law of the sea, *International waters, Commercial fishing, International commissions, Treaties, United Nations, United States, Oceans, Beds, Fishing, Conservation, Legal aspects, Fisheries.
Identifiers: *Ecuador, *Territorial sea.

Discussing the dispute over fishing rights in the Pacific Ocean off the coast of Ecuador, this article first discusses the historical basis for nations' claims to territorial waters, controversies that have arisen, and trends toward expansion of the territorial limit. It is the general consensus that a nation has exclusive fishing rights in what is determined to be its territorial sea and in the sea bed and sub-soil under the territorial sea. Ecuador claims sovereignty to a distance of 200 miles, while the United States recognizes a 12-mile limit. In considering the positions of Ecuador and the United States, the author concludes that Ecuador's position is not in opposition to historically recognized legal principles. The problem is that it is in the interests of smaller nations to claim a large territorial sea while it is in the interests of larger nations to assert a narrow one. Factors influencing such preferences include the relative sizes of national fishing fleets and the availability of fish in various areas. The author notes that Ecuador has been willing to negotiate fishing rights and concludes that there will be accommodation in this area when larger nations recognize the legitimate interests of smaller nations. (Duss-Florida)
W71-04984

ATTORNEY GENERAL'S OPINION ON CONFLICT BETWEEN FLORIDA AIR AND WATER POLLUTION CONTROL ACT AND OIL SPILL PREVENTION AND POLLUTION CONTROL ACT.
Florida State Dept. of Legal Affairs, Tallahassee.

1970 Florida Attorney General Opinions, No 070-121, Sept 2, 1970. 6 p.

Descriptors: *Florida, *Legislation, *Pollution abatement, *Administrative agencies, State governments, Administrative decisions, Water pollution, Water pollution control, Pollutants, Public health, Air pollution, Oil, Oily water, Legal aspects.

This opinion of the Florida Attorney General answers the following questions: (1) does the Oil Spill and Pollution Control Act (Chapter 70-244) conflict with the Air and Water Pollution Control Act (Chapter 403); (2) if this legislation conflicts, which agency has responsibility for conflicts in the area; (3) does Chapter 70-244 conflict with the 1969 Governmental Reorganization Act. Responding to question 1, it was observed that where there is comprehensive legislation like Chapter 403, and a later act applies only to a particular aspect of the same subject, the statute relating to a particular part operates as an exception to the general law. The Attorney General concluded that there was no conflict. The Attorney General noted that the agencies should cooperate in favor of the public interest, but that if a conflict arose the later act would prevail. Since a response to question 3 would involve passing on a matter of legislative discretion, the Attorney General declined to answer it. He stated that the Department of Air and Water Pollution Control is the actual pollution control agency of Florida, subject to the exceptions in Chapter 70-244 relating to oil and other pollutants spilled in the coastal areas subject to control of the Department of Natural Resources. (Hart-Florida)
W71-04985

CONSERVATION, CONTROL, AND USE OF WATER RESOURCES OF THE MISSOURI RIVER BASIN.
Department of the Interior, Washington, D.C.

US Senate Document 191, 78th Cong, 2d Sess, April 1944. 211 p, 24 map, 137 tab, 16 chart, 5 append.

Descriptors: *Reclamation, *Multiple-purpose projects, *Water resources development, *River basin development, Watersheds (Basins), Regional analysis, Water conservation, Water distribution (Policy), Project purposes, Water policy, Water resources, Cost-benefit analysis, Federal project policy, Federal government, Flood control, Pollution abatement, Recreation, Irrigation, Water levels, Navigation, Hydroelectric plants, Interbasin transfers, Legislation, Inter-agency cooperation, Administration, Wildlife conservation.
Identifiers: *Missouri River Basin.

A description of the Missouri River Basin, the state of its 1944 development, and the Bureau of Reclamation's plan for its future development are presented in this report. The plan described deals with the conservation and control of water resources in the Basin and the use of such resources in watershed development. The plan encompasses all water resources and all feasible beneficial uses of water, including: (1) aids to navigation (2) flood control, (3) irrigation, (4) power production, (5) the restoration of surface and groundwater levels and municipal and domestic water supplies, (6) abatement of stream pollution, (7) silt control, (8) fish and wildlife preservation, and (9) recreation. Dams, hydroelectric plants, reservoirs, and other projects designed to maximize beneficial use of water resources are analyzed in terms of annual project costs, benefits, and repayment and return schedules. Six geographical areas within the basin are examined as to: (1) such factors as land use, water quality, climate, minerals, markets and transportation, surface and groundwater resources, and soils; (2) existing state of water resources development; and (3) future projects and plans for development. A detailed physical and economic description of the entire Basin is also presented. (Earl-Florida)
W71-04986

FISHERIES AND THE NEW CONVENTIONS ON THE LAW OF THE SEA,
Francis T. Christy, Jr.
San Diego Law Review, Vol 7, No 3, p 455-468, July 1970. 14 p, 2 tab, 17 ref.

Descriptors: *Marine fisheries, *International law, *International commissions, *International waters, Commercial fishing, Fish, Fish harvest, Fish hatcheries, Fish migration, Fishing, Fish management, Fish populations, Commercial fish, Legal aspects, Mineralogy, Mineral industry, United States, Foreign countries, Treaties.

The Geneva Conventions on the Law of the Sea are expected to consider problems of international marine fisheries, although debate has previously been exclusively devoted to marine mineral resources and military interests. The author anticipates difficulty in solving the problems of conflicting national interests in marine fisheries and raises five points to be considered by the delegates to the commission: (1) despite the inordinate complexity of fisheries problems, the issues and alternative solutions have not been formulated with particularity; (2) over-emphasis on seabeds may cause short-term gains for mineral interests at the expense of long-term damages to fisheries interests; (3) the character of the Conventions will be far different from the 1958 Conventions, because of the split between developing and developed nations and fear of a U.S.-U.S.S.R. fisheries coalition; (4) the world community is realizing that the patterns of distribution of the sea's wealth in fisheries among nations is becoming more non-inclusive, and the opportunities for sharing more restrictive; and (5) the non-inclusive patterns of distribution are supported by customary and conventional law. The author feels that the delegates to the Conventions are unprepared to adequately discuss the fisheries problems and hopes the Conventions can be delayed until the issues become clearer. (Hart-Florida)
W71-04987

ADARAY REALTY CORP V FABER (RESTORATION OF UPLAND TITLE BY FILLING SUBMERGED LAND).
235 NYS 660-661 (Sup Ct App Div 1929).

Descriptors: *New York, *Riparian land, *Landfills, *Ownership of beds, Riparian waters, Riparian rights, Dredging, Land forming, Beds, Shores, Seashores, Oceans, Beach erosion, Banks, Bank erosion, Erosion, Land tenure, Boundaries (Property), Boundary disputes, Legal aspects, Judicial decisions.

Plaintiff realtor brought action against defendant riparian owner to settle a dispute over boundaries of property subject to a sale contract in which defendant was vendor. Plaintiff contended that defendant's title was defective because a large part of defendant's upland had been lost due to encroachment by the ocean at the time of contract execution. Defendant contended that his title had been restored, since the city had filled in the land prior to the closing date. The Supreme Court of

New York noted that one holding title to submerged land could restore his upland by filling, whereas title to land vested in the state could not be gained by filling. The court held that plaintiff failed to prove that title to the submerged land was in the state rather than defendant and thus failed to show that defendant could not restore his upland by filling. Judgment for defendant was affirmed. (Liptak-Florida)
W71-04988

OIL POLLUTION AT SEA,
For primary bibliographic entry see Field 05G.
W71-04989

OIL POLLUTION AND THE LAW,
For primary bibliographic entry see Field 05G.
W71-04990

OIL SPILLAGE PREVENTION, CONTROL, AND RESTORATION--STATE OF THE ART AND RESEARCH NEEDS,
For primary bibliographic entry see Field 05G.
W71-04991

OIL POLLUTION: A REPORT TO THE PRESIDENT.
For primary bibliographic entry see Field 05G.
W71-04992

NATIONAL MULTI-AGENCY OIL AND HAZARDOUS MATERIALS POLLUTION CONTINGENCY PLAN.
For primary bibliographic entry see Field 05G.
W71-04993

WISE USE OF FLOOD PLAINS.
New England River Basins Commission, Boston, Mass.
For primary bibliographic entry see Field 06F.
W71-04994

SURFACE WATER CONTROL IN NEW JERSEY, DRAINAGE, FLOOD CONTROL AND RELATED POLICIES IN AN URBAN STATE,
Rutgers-The State Univ., New Brunswick, N.J. Bureau of Government Research.
For primary bibliographic entry see Field 04A.
W71-04995

A SUMMARY OF MASSACHUSETTS STATE LAWS, POLICIES AND PROGRAMS PERTAINING TO WATER AND RELATED LAND RESOURCES.
Massachusetts Water Resources Commission, Boston. Div. of Water Resources.

1969. 127 p, 2 chart.

Descriptors: *Massachusetts, *water resources, *Water law, *Water policy, Development, Legal aspects, Project purposes, Project planning, Planning, Administration, Administrative agencies, Inter-state commissions, River basin commissions, Watershed management, Water quality control, Judicial decisions, Legislation, Riparian rights, Conservation, Land, Financing, Eminent domain, Public rights.

Utilizing constitutional and statutory provisions, 12 important state court decisions, and several significant attorny general opinions, this report contains a synopsis of all Massachusetts law relative to water resources. Included in the report are discussions of: (1) the state's riparian rights doctrine, (2) private and public rights in surface and groundwater, (3) access to lakes and streams, (4) interbasin diversions, and (5) eminent domain problems. The report lists the projects for which permits or approval are needed and the responsible agency's function in granting such permits. Also described, along with a chart of the state government and a reorganization of state agencies to be implemented in 1971, are the organization and functions of four interstate and 21 state commissions and agencies having jurisdiction over water resources problems. Different policy and management approaches and concepts are discussed and compared. The report describes also programs in research, data collection and interpretation, planning, construction and development, regulation, drainage, irrigation, erosion control, and reservoir sites. The report discusses projections of policy, program trends, and future financing prospects, and concludes with a summary of water management problems in the areas of water supply, flood control, forestry and watershed management, hydropower, water quality control, and recreation. Specific recommendations for solving some of these problems are presented. (Liptak-Florida)
W71-04996

WATER RESOURCES PLANNING SEMINAR,
Florida State Board of Conservation, Tallahassee. Div. of Water Resources and Conservation.
For primary bibliographic entry see Field 06B.
W71-04997

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 7, SECTION I - FIVE LEGAL STUDIES ON WATER QUALITY MANAGEMENT IN WISCONSIN,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W71-05040

HAYNIE V MAY (TITLE TO ACCRETED LANDS WHEN ADJACENT UPLAND IS CONVEYED).

252 NW 749-754 (Iowa 1934).

Descriptors: *Iowa, *Accretion (Legal aspects), *Missouri River, *Boundary disputes, Boundaries (Property), Contracts, Adjudication procedure, Legal aspects, Judicial decisions, Real property, Land tenure, Navigable waters.

In a suit to quiet title to riparian land, the Supreme Court of Iowa stated that by recording his deed and plat, and holding himself out as the owner of the disputed land, plaintiff had acquiesced in the description of the property in the deed although a court would have decided title to the accretions differently. In a later contract for sale of the same land utilizing the identical description, plaintiff was held to have conveyed title to the accretions as well as the upland. (Hart-Florida)
W71-05106

LOUISIANA V MISSISSIPPI (BOUNDARY DISPUTE BETWEEN STATES, INVOLVING ACCRETION AND SUBSEQUENT AVULSION).
282 US 458, 51 S Ct 197-201 (1931).

Descriptors: *Louisiana, *Mississippi, *Accretion (Legal aspects), *Boundary disputes, Local governments, Judicial decisions, Remedies, Legal aspects, Mississippi River, Navigable rivers, Navigable waters, Islands, Channel erosion, Banks, Bank erosion, Avulsion, Boundaries (Property), Interstate rivers.

Louisiana brought suit to determine the location of the boundary between a portion of Louisiana and a portion of Mississippi. Louisiana contended that the thread of the Mississippi River channel had moved gradually eastward between 1823 and 1913, with an island disappearing and land accreting to the Louisiana shore and becoming part of Louisiana. An avulsion in 1912 to 1913 changed the channel westward, cutting off the land that had previously attached to Louisiana. Louisiana claimed that the avulsion did not change the boundary previously formed by accretion. Mississippi agreed that the 1912-1913 avulsion did not change the boundary, but contended that the earlier eastward movement of the river channel was an avulsion rather than accretion, thus the land had remained in Mississippi. The Supreme Court of the United States, in accepting a master's report, held the eastward change was by accretion, thus Louisiana gained the Land. The court also noted that evidence was inconclusive to show Mississippi had exercised continued dominion over the land or that Louisiana had acquiesced in any such dominion. (Morris-Florida)
W71-05117

NEW JERSEY V CITY OF NEW YORK (CITY DUMPING GARBAGE IN OCEAN AS NUISANCE).
283 US 473, 51 Sup Ct 519-522 (1931).

Descriptors: *New Jersey, *Domestic wastes, *Water pollution, *Water pollution effects, Water pollution sources, Water pollution control, Pollution abatement, Pollution identification, Legal aspects, Judicial decisions, Remedies, Permits, State governments, Local governments, Garbage dumps, Municipal wastes, Incineration, Oceans, Atlantic Ocean, Beaches, Shores, Cities.

Plaintiff state sought to enjoin defendant city from dumping garbage in the ocean. Plaintiff claimed the garbage washed ashore on its beaches, causing a health menace and great expense to the state and its resorts. Defendant asserted that the dumping was done under federal permit and outside the territorial waters of the United States and thus was outside the Court's authority. Defendant also claimed that other sources also dumped waste in the same area and that it would be impossible to attribute the injury to defendant. The Supreme Court of the United States accepted a master's finding that the garbage did constitute a nuisance and that the defendant was the primary source of the garbage. The Court also noted that defendant had been aware of the nuisance for years and had not acted sufficiently to remove it, although defendant also used some incinerators to destroy garbage. The Court held that the permit did not relieve defendant of liability for a nuisance and that the situs of the dumping was unimportant since the site of the injury and both parties were within the Court's jurisdiction. (Morris-Florida)
W71-05125

SMOOT SAND AND GRAVEL CORP V WASHINGTON AIRPORT, INC (BOUNDARY DISPUTES BETWEEN STATES ON THE POTOMAC RIVER).
283 US 348, 51 Sup Ct 474-476 (1931).

Descriptors: *Virginia, *Maryland, *Boundary disputes, *Interstate rivers, District of Columbia, Local governments, Federal government, Legal aspects, Judicial decisions, High water mark, Low water mark, Legislation, Boundaries (Property), Riparian land, Navigable waters, Banks, Rivers.
Identifiers: *Potomac River.

Plaintiff airport sought to enjoin defendant gravel corporation from trespassing on land between the high and low water marks on the Virginia side of the Potomac River, opposite the District of Columbia. Plaintiff brought suit in Virginia, but a federal district court dismissed for lack of jurisdiction over the area. The question which faced the Supreme Court of the United States was whether the boundary line between Virginia and the District of Columbia is the high or low water mark on the Virginia side of the Potomac. The Court held that the original conveyance to Lord Baltimore was along the farther bank of the river, which would mean the high water mark. Thus the Court held that Virginia courts would not have jurisdiction over the area. A dissenting opinion claimed the decision was contrary to the Court's earlier holding that the Compact of 1785 between Virginia and Maryland set Maryland's southern boundary at the low water mark of

the south bank of the Potomac. The District retained Maryland's boundary when it was created. (Morris-Florida)
W71-05133

VERMONT V NEW HAMPSHIRE (BOUNDARY DISPUTE INVOLVING RIVER BETWEEN STATES).

289 US 593, 53 Sup Ct 708-718 (1933).

Descriptors: *Vermont, *New Hampshire, *Boundary disputes, *Interstate rivers, Low water mark, High water mark, Legal aspects, Judicial decisions, Local governments, Federal government, Boundaries (Property), Legislation, Navigable waters, Navigable rivers, Rivers, Banks, Riparian land, River beds, Ownership of beds, Vegetation, Shoreline cover.

The state of Vermont brought a suit to determine the boundary line between Vermont and the state of Massachusetts. Vermont asserted the boundary should be the thread of the channel of the Connecticut River. Massachusetts claimed the boundary should be the top of the western bank of the river, which would mean the line where vegetation ceases. Both states relied on various historical and colonial documents, but no dispute had occurred between them until New Hampshire attempted to tax corporations and persons with structures on the west bank. A special master concluded that the ordinary low water mark on the western side of the river was the proper boundary. The master based his opinion on the congressional resolution of 1781 setting terms for Vermont's admission to the Union and the Vermont legislature's resolution of 1782 relinquishing claims east of the low water mark in accordance with congressional wishes. The Supreme Court of the United States adopted the master's report, based on the acts of the states and their inhabitants in relying on the low-water mark for over 100 years. (Morris-Florida)
W71-05140

NEW JERSEY V CITY OF NEW YORK (REMEDY AGAINST CITY FOR POLLUTION OF STATE WATERS AND BEACHES).
290 US 237, 54 Sup Ct 136-137 (1933).

Descriptors: *New Jersey, *Water pollution, *Domestic wastes, *Waste disposal, Oceans, Shores, Coasts, Cities, Beaches, Incinerators, Damages, Remedies, Costs, Wastes, Judicial decisions, Legal aspects, Water pollution sources, New York.

Plaintiff state of New Jersey sought to enjoin defendant city of New York from dumping garbage into the ocean, thereby polluting New Jersey waters and beaches. The Supreme Court of the United States appointed a special master to hear the case. The master found that defendant had created and was continuing to create a public nuisance and that plaintiff was entitled to the relief prayed for. He recommended that defendant be given a reasonable time in which to install incinerators to dispose of its garbage. The Court approved the master's report and issued a decree specifying a time after which the injunction would take effect. Defendant failed to install the incinerators in time to comply with the decree, and plaintiff filed a petition asking defendant to show cause why it should not be held in contempt. Defendant answered that inadequate financial means had caused the delay and prayed for an extension. The Supreme Court granted the extension, awarded damages to plaintiff for expenditures by its political subdivisions in dealing with the pollution, and provided for a daily penalty if defendant did not comply with the decree within the new time limit. (Duss-Florida)
W71-05142

NEW JERSEY V CITY OF NEW YORK (OFF-SHORE SEWAGE SLUDGE DISPOSAL).
296 US 259, 56 Sup Ct 188 (1935).

Descriptors: *New Jersey, *New York, *Sewage disposal, *Waste disposal, Waste water disposal, Municipal wastes, Sanitary engineering, Sludge disposal, Waste dumps, Wastes, Legal aspects, Judicial decisions, Cities, Water pollution, Adjudication procedure, Water pollution control.

Plaintiff state obtained an injunction prohibiting defendant municipality from dumping refuse into the ocean waters off the coast of plaintiff. Defendant dumped nonfloating sewage sludge consisting of 90 percent water and 10 percent finely divided solids at places not less than 10 miles from plaintiff's shore. Defendant filed a petition for construction or modification of the injunction decree to determine if defendant had violated the court order. The United States Supreme Court held that the dumping of sludge, free from any matter capable of floating, was not a violation of the decree. (Powell-Florida)
W71-05146

PROPERTY: THE FIXED LAW OF CHANGING BOUNDARIES,
Douglas H. Lefeve, and Ernest G. Taylor.
Mississippi Law Journal, Vol 41, No 2, p 444-456, 1970. 13 p, 96 ref.

Descriptors: *Boundaries (Property), *Accretion (Legal aspects), *Avulsion, *Thalweg, Boundary disputes, Bank erosion, Riparian land, Riparian rights, Riparian waters, Judicial decisions, Legal aspects, Rivers, Navigable rivers, Streams, Mississippi River, Prescriptive rights, Adjudication procedure.

In this note pertaining to changes in size and shape of land bordered by a river or stream, the following riparian doctrines are discussed: (1) accretion, (2) thalweg, (3) avulsion, and (4) prescription and acquiescence. Accretion is defined as an imperceptible increase in riparian land by either natural or artificial means. The author states that title to an accretion is vested in the riparian owner whose land to which it attached. The origin and justifications for the accretion doctrine are analyzed. Thalweg is defined as the middle or thread of a navigable river forming the boundary between coterminous states. Since the thalweg changes continuously, the author notes that the states' boundary varies with it. This prevents one state from excluding the other from its right of navigation. Avulsion is defined as a stream's sudden departure from its old bed into a new one. It is stated that avulsion causes no legal change in boundaries. The prescription and acquiescence doctrine allows a state to acquire land originally belonging to another. The procedural problems of litigation and disputes are discussed, and the author concludes that the avulsion rule should be eliminated. (Hart-Florida)
W71-05179

COUNCIL ON ENVIRONMENTAL QUALITY; STATEMENTS ON PROPOSED FEDERAL ACTION AFFECTING THE ENVIRONMENT.
Federal Register, Vol 36, No 19, Thursday, January 28, 1971, p 1398-1402.

Descriptors: *Environmental effects, *Administrative agencies, *Project planning, *Decision making, Conservation, Federal government, United States, Administration, Planning, Natural resources, Legislation, Water resources development, Adoption of practices, Legal aspects, Governments, Costs, Jurisdiction.
Identifiers: *National Environmental Quality Act.

To implement the purposes of the National Environmental Quality Act, the Council on Environmental Quality herein proposes guidelines for the preparation of statements on proposed federal action affecting the environment. The Act requires all federal agencies anticipating proposals for legislation, or other agency action having potential effect on the quality of the environment, to prepare a detailed statement outlining the environmental impact of the proposal. The guidelines describe agency procedures, which actions are considered with the Act, and which agencies are responsible for preparing statements. Statements are to include the probable impact of the proposed action on the environment, adverse environmental effects which cannot be avoided, analysis and costs of alternative action, the relationship between short-term and long-term effects of the action, any irreversible committments of resources involved in the action, and any discussion or objection raised by other federal, state, or local agencies. Federal agencies having jurisdiction or expertise in certain areas must be consulted and are listed in an appendix. Action should not be taken until the Council has had at least 90 days to consider the statement. The procedure also allows for state and local review, public hearings and public dissemination of the environmental statements. (Liptak-Florida)
W71-05180

THE BACKGROUND OF THE DOCTRINE OF THE CONTINENTAL SHELF AND THE OUTER CONTINENTAL SHELF LANDS ACT,
Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif.
Robert B. Krueger.
Natural Resources Journal, Vol 10, No 3, p 442-514, 1970. 73 p, 4 fig, 191 ref, 5 append.

Descriptors: *Continental Shelf, *Exploitation, *History, *International law, Legislation, Foreign countries, United States, Continental slope, Mineralogy, Oceans, Submerged Lands Act, Legal aspects, Judicial decisions, United Nations, Oil, Oil wells.
Identifiers: *Outer Continental Shelf Lands Act.

The necessity for exploitation of offshore mineral resources is directly related to the development of the Continental Shelf doctrine. The purpose of this article is to examine the background of the doctrine and the Outer Continental Shelf Lands Act. The controversy within the United Nations over use and jurisdiction of riparian nations in the Continental Shelf is discussed. In examining the background of the Outer Continental Shelf Lands Act, the author considers: (1) the Submerged Lands Act, (2) the 1945 Truman Proclamation, (3) the Outer Continental Shelf Lands Act, (4) the 1958 Geneva Convention on the Continental Shelf, (5) customary international law, and (6) the 1970 Nixon proposal for the United States ocean policy. In his discussion of the 1958 Geneva Convention, the author analyzes; (1) preconvention claims, (2) definition of the Continental Shelf, (3) provisions of the Convention, (4) claims under the Convention, and (5) recent international developments. Five appendices set forth: (1) the Submerged Lands Act; (2) the Convention on the Territorial Sea and the Contiguous Zone; (3) the Outer Continental Shelf Lands Act; (4) the Truman Proclamation; and (5) the Convention on the Continental Shelf. (Hart-Florida)
W71-05181

SOME LEGAL PROBLEMS INVOLVED IN SAVING GEORGIA'S MARSHLANDS,
Fiquilliat and Abbot, Savannah, Ga.
Laurie K. Abbott.
Georgia State Bar Journal, Vol 7, No 1, p 27-36, 1970. 10 p.

Descriptors: *Georgia, *Marshes, *Estuaries, *Tidal marshes, Legal aspects, Legislation, Administrative agencies, State governments, Land reclamation, Marsh management, Judicial decisions, Eminent domain, Coordination, Permits, Land fills, Real property, Land tenure, Dredging.

There are many conflicting uses for Georgia's coastal marshlands. This article examines the legal difficulties involved in conserving these marshlands. An act in 1860 extended title from the uplands to the low water mark of adjacent navigable streams; accordingly, holders contiguous to the marshlands considered them their own. However, a later Georgia Supreme Court decision held that the act did not apply to marshlands. This defect was

cured by legislation and a constitutional amendment. In 1970, the Georgia Attorney General held that the marshlands belonged to the state. The author analyzes the Attorney General's opinion, concluding that its foundation is tenuous. Next, the author examines the Coastal Marshlands Protection Act which requires a permit from the Coastal Marshlands Protection Agency for dredging and filling in the marshlands. It is stated that this act must withstand three tests: (1) Can zoning power be delegated to a state agency; (2) Is the agency's refusal to grant a permit an uncompensated taking without due process; and (3) Is a permit applicant afforded due process by the procedures set forth in the act. (Hart-Florida)
W71-05182

FLORIDA BARGE CANAL.
Congressional Quarterly, Vol 29, p 199, 202, Jan 1971. 2 p.

Descriptors: *Florida, *Canal construction, *Natural resources, *Canals, Conservation, Construction, Construction costs, Rivers, Streams, Navigation, Governments, Decision making, Land resources, Water resources development, Wildlife conservation, Preservation, Water policy, Transportation, Ships, Economics, Environmental effect.
Identifiers: *Executive orders.

Following the advice of the Council on Environmental Quality, President Nixon ordered the Army Corps of Engineers to stop construction on the cross-Florida barge canal. The stop order was opposed by Florida's Congressional delegation, which planned to meet to consider possible counter measures. Conservationists opposed the canal because it would damage the unique wildlife and natural semi-tropical beauty in that part of the state. Conservationists had successfully obtained a temporary court order halting the canal and, prior to the President's order, had planned continuing litigation. The text of the President's statement noted that the canal was conceived when federal planning was focused purely on economic return without regard for destruction of the ecology as a cost factor. The President pointed out the uniqueness of the region's wildlife resources, describing it as a 'natural treasure.' The President also asked the Secretary of the Army to aid the Council on Environmental Quality in developing recommendations for the future use of the canal area. (Liptak-Florida)
W71-05183

PERMITS FOR DISCHARGES OR DEPOSITS INTO NAVIGABLE WATERS.
Corps of Engineers, Washington, D.C.

Federal Register, Vol 35, No 253, Thursday, December 31, 1970, p 20005-20009.

Descriptors: *Navigable waters, *Waste disposal, *Permits, *Rivers and Harbors Act, Administration, Wastes, Environmental effects, Conservation, United States, Natural resources, Legislation, Regulation, Water quality, Administrative agencies, Project planning, Decision making, Adoption of practices, Water pollution control, Pollution abatement, Effluents, Waste water (Pollution), Water quality control, Pollutants, Administrative decisions, State governments.
Identifiers: Administrative regulations.

Pursuant to Executive Order 11574 directing the implementation of a permit program under the Refuse Act, the Secretary of the Army herein proposes the policy, practice, and procedure to be followed by the Corps of Engineers in granting permits authorizing the discharge of refuse or other matter into United States navigable waters. As a general policy, all discharges into navigable waters are unlawful and will only be authorized after an evaluation of the probable impact on: (1) anchorage and navigation, (2) applicable water quality standards, and (3) fish and wildlife. The Corps will not issue a permit where the state has denied certification under the Federal Water Pollution Control Act, and the findings of the Environmental Protection Agency as to probable impact upon water quality standards will be followed. Permit applicants must supply specified information on the character of the proposed discharge and must also furnish state certification. The Corps will furnish copies of the application to the EPA and other interested agencies for their views and recommendation. The Corps shall give public notice of the application and may hold a public hearing. If the discharge will have a significant environmental impact, the Corps must submit an environmental impact statement to the Council on Environmental Quality. Permits may not be issued for more than 5 years without providing for revalidation. (Liptak-Florida)
W71-05184

DEEP SEA MINING,
F. M. Auburn.
American Bar Association Journal, Vol 56, p 975-976, 1970. 2 p, 7 ref.

Descriptors: *International law, *Continental Shelf, *Continental Margin, *Exploitation, Law of the sea, International waters, Mining, Regime, Regulation, Beds under water, Administrative agencies, Administration, Jurisdiction, United States, United Nations, Federal government, Governments, Oil industry, Treaties, Political aspects, Political constraints, Institutional constraints, Boundary disputes, Legal aspects, Judicial decisions.
Identifiers: *Deep sea mining.

Evaluated in this article are recent proposals, United Nations proceedings, and court decisions relating to exploitation of the ocean bed, Continental Shelf, and Continental Margin. Three United Nations resolutions dealing with this area are considered. Concurrent, and often conflicting, developments within the United States are reviewed. The views of the American Petroleum Institute, the United States Navy, the Department of the Interior, and the federal courts are compared with attempts to establish international regimes to govern such areas. The author suggests that a recent proposal by President Nixon may serve as a basis for resolving both international and domestic conflicts in the area of deep-sea exploitation. The Nixon Proposal of May 25, 1970, suggests an international treaty renouncing all national claims to sea-bed resources below 200 meters. It would provide for: (1) an international regime to exploit such resources, (2) coastal states to act as trustees, and (3) machinery to regulate exploitation beyond the Continental Margin. The proposal is examined and evaluated by the author, who suggests possible amendments. (Earl-Florida)
W71-05185

WATER RESOURCES COUNCIL; COUNCIL ORGANIZATION.
Water Resources Council, Washington, D.C.

Federal Register, Vol 35, No 146, Wednesday, July 29, 1970, p 12105-12113.

Descriptors: *Water Resources Planning Act, *Administrative agencies, *Grants, *Administrative decisions, Federal government, Adoption of practices, Institutional constraints, Inter-agency cooperation, Decision making, Leadership, Organizations, Regulations, Coordination, Management, Personnel management, Project-planning, Federal project policy, Water resources, Legislation, Allotments, Legal aspects.
Identifiers: *Water Resources Council.

Set forth in this administrative promulgation is a description of the organizational structure, functions, and grant procedures of the Water Resources Council. The Council's basic authority under the Water Resources Planning Act, its purposes, functions, organizational pattern, and office locations are set forth. The responsibilities and structure of the Council are described, including: (1) the Council itself; (2) decisions by members and representatives; (3) the role of associate members and observers; (4) subordinate groups, (5) the Secretary, Chairman, Director, and other officers; (6) official decisions; and (7) delegation of the Director's powers. The Council's field organization, including field directors, field committees, and existing committees, is also set forth. Council regulations and procedures applicable to grants to the states under the Water Resources Planning Act are provided, listing: (1) allotment criteria; (2) application procedures; (3) federal agency coordination considerations; (4) annual reporting and review requirements; and (5) other grant standards and regulations. (Earl-Florida)
W71-05186

WATER RESOURCES COUNCIL; POLICIES AND PROCEDURES IN PLAN FORMULATION AND EVALUATION OF WATER AND RELATED LAND RESOURCES PROJECTS.
Water Resources Council, Washington, D.C.
For primary bibliographic entry see Field 06C.
W71-05187

RECLAMATION AND IRRIGATION OF LANDS BY FEDERAL GOVERNMENT.

43 USCA secs 425 thru 425b, 616 mmmm thru 616 yyyy (Supp 1970).

Descriptors: *Irrigation programs, *Irrigable land, *Federal project policy, *Federal reclamation law, Arid lands, Legal aspects, Public lands, Reclamation, Irrigated land, Irrigation, Irrigation effects, Irrigation systems, Irrigation water, Administrative agencies, Federal government, State governments, Local governments, Cities, Recreation, Wildlife conservation, Fish conservation, Cost repayment, Oregon, Washington, Legislation, State governments.
Identifiers: *Federal Water Project Recreation Act.

Those provisions of federal reclamation laws which limit the acreage of irrigable land which may receive irrigation benefits shall not be applicable to lands owned by states, political subdivisions and agencies thereof, so long as such lands are farmed as herein provided. Under the conditions here set forth, irrigable state-owned lands may receive water from federal reclamation projects. Lessees of state-owned irrigable lands which are subject to the acreage limitation may receive project waters for up to a limit of 25 years. This act also authorizes the construction, operation and maintenance of: (1) the Merlin Division of the Rogue River Project in Oregon, and (2) the Touchet Division of the Walla Walla Project in Oregon and Washington. Standards are prescribed for these projects. In both projects conservation and the development of fish and wildlife resources, and the enhancement of recreation opportunities, shall be in accordance with the Federal Water Project Recreation Act. Irrigation repayment contracts must provide for cost repayment within 50 years. (Hart-Florida)
W71-05188

SHELDON V SEVIGNY (BOUNDARY OF PROPERTY ABUTTING ON A STREAM).

272 A2d 134-137 (NH 1970).

Descriptors: *Streams, *Boundary disputes, *Boundaries (Property), *New Hampshire, Surveys, Land tenure, Real property, Zoning, Septic tanks, Cities, Legal aspects, Judicial decisions.

Plaintiff landowner brought action to prevent defendant adjacent landowner from installing a septic tank within the confines of plaintiff's land and thereby violating a zoning ordinance. The case evolved into a boundary dispute between the two lots purchased from a common grantor. Both deeds described the common boundary as running along the bank of a brook. Plaintiff contended that the

surveyor's measurements were from the thread of the brook when they should have been from the bank. Defendant supported the survey. The court stated that in the absence of a clearly expressed intent to limit a grant to the bank, title runs to the thread of the stream. Since no such intent was found, the court rejected plaintiff's contention. (Hart-Florida)
W71-05189

REGULATION OF TRANSPORTATION IN INTERSTATE OR FOREIGN COMMERCE OF BLACK BASS AND OTHER FISH.
16 USCA secs 851 thru 852d (Supp 1970).

Descriptors: *Fish, *Transportation, *Bass, *Fish conservation, Legislation, Administrative agencies, Foreign countries, Federal government, Regulation.
Identifiers: *Interstate commerce.

The transportation of any black bass or other fish in interstate or foreign commerce with knowledge that the transportation is contrary to the law of the state in which the fish originated, or that the fish were illegally caught, is prohibited. Moreover, purchasing or receiving any fish with knowledge that the fish were transported in violation of this act is unlawful. Receiving black bass or other fish with knowledge that a false record of the shipment was made is also unlawful. Containers in which fish are shipped must be conspicuously marked 'fish', and the name and address of the shipper and the consignee must be included. Employees of the Department of the Interior are authorized to enforce the act and are empowered: (1) to arrest without a warrant any person violating the provisions in his presence; (2) to execute any warrants issued to enforce the act; and (3) to make searches under a valid warrant. Warrants may be issued upon probable cause. (Hart-Florida)
W71-05190

ANIMALS, BIRDS, FISH AND PLANTS (SPECIFIC TRANSPORTATION OF, AND DEALINGS IN, WILDLIFE AS ILLEGAL).

18 USCA secs 43 thru 44, as amended, (Supp 1970).

Descriptors: *Wildlife conservation, *Fish, *Transportation, *Wildlife, Legislation, Administrative agencies, Animals, Birds, Plants, Remedies, Federal government, Foreign countries, Administration, Regulation, State governments, United States, Mexico, Permits.
Identifiers: *Interstate commerce.

It shall be a violation of this act for any person to: (1) transport or deal in wildlife in violation of an act of Congress; (2) transport or deal in wildlife in violation of state law or the law of a foreign nation; (3) sell products manufactured from wildlife in violation of an act of Congress; (4) sell products manufactured from wildlife; (5) make a false record of wildlife shipped in interstate commerce; (6) purchase any wildlife for commercial purposes which was taken in violation of an act of Congress or in violation of the law of a state or foreign nation; or (7) import any wild game from Mexico without a permit from the Secretary of the Interior. Violators shall be subject to the following penalties: (1) a civil penalty of $5000 for violation with actual or imputed knowledge; (2) a criminal penalty, for knowing and willful violation, of up to $10,000 and/or one year imprisonment. Any wildlife seized shall be forfeited to the Secretary of the Interior. Employees authorized by the Secretary to enforce the act may execute warrants to search for and seize wildlife or wildlife products. (Hart-Florida)
W71-05191

NATIONAL FLOOD INSURANCE (EXTENSION OF FLOOD INSURANCE TO MUDSLIDES).

42 USCA secs 4001, 4012c, 4022, 4056, 4121 (Supp 1970).

Descriptors: *Mudflows, *Insurance, *Flood damages, *Flood plain insurance, Legislation, Damages, Compensation, Legal aspects, Risks, Mud, Floods, Administrative agencies, Federal government, Land use, Administration.

Since damage and loss resulting from mudslides is related to storms and floods, this amendment makes national flood insurance applicable to mudslides. The term 'flood' for the purposes of flood insurance programs also includes inundation from mudslides. However, insurance is available only in areas which have satisfied the Secretary of Housing and Urban Development that adequate land use and control measures will be implemented. (Hart-Florida)
W71-05192

MARTIN V BUSCH (OWNERSHIP OF LAKEBEDS RELICTED BY STATE DRAINAGE OPERATION).
112 So 274-288 (Fla 1927).

Descriptors: *Florida, *Land tenure, *Ownership of beds, *Boundary disputes, Boundaries (Property), Beds under water, Beds, Lakes, Littoral, Navigable waters, Riparian land, Riparian rights, Accretion (Legal aspects), Administrative agencies, Real property, State governments, Reservation doctrine, Judicial decisions, Legal aspects, High water mark.

Plaintiff swampland owner sought to quiet title to lands against claims of defendant Florida Improvement Fund trustees. The disputed land was coveyed to plaintiff's predecessor by defendant before Lake Okeechobee was meandered. The boundary of the conveyance was Lake Okeechobee. After the conveyance, defendants had the lake meandered. Due to a drainage operation by the state, the lake had receded. Both parties claimed the land between the high water mark at the time of the conveyance and the meander line. The Supreme Court of Florida stated that: (1) 'navigable waters' include all waters capable of practical navigation for useful purposes; (2) on admission to the Union, the state became owner of beds of navigable lakes to high water mark; (3) best evidence and methods should be used to determine the location of the high water mark; (4) lands below high water mark are 'sovereignty lands,' while those above are 'swamp lands'; and (5) right to land below high water mark must be specifically claimed. The court further noted that relicted land does not inure to a riparian owner where it recedes as a result of a state drainage operation for a public purpose. Since defendant had no authority to convey beds of navigable waters, the court held title in defendant. (Hart-Florida)
W71-05193

WATER PROJECTS -- A CHANGING PERSPECTIVE,
Sierra Club, San Francisco, Calif.
For primary bibliographic entry see Field 06B.
W71-05195

UNITED STATES V MAYOR AND CITY COUNCIL OF HOBOKEN (DOCKS MAY BREACH RIGHT OF RE-ENTRY FOR CONDITION BROKEN).

29 F2d 932-949 (D NJ 1928).

Descriptors: *New Jersey, *Docks, *Land tenure, *Ownership of beds, Beds, Beds under water, Cities, State governments, Hudson River, Rivers, Navigable rivers, United States, Taxes, Legal aspects, Judicial decisions.

Plaintiff United States brought action to have realty located within defendant city declared permanently tax exempt. The property was a portion of the Hudson River's bed which had been conveyed to a German Steamship line by defendant. A convenant in the conveyance prohibited erection of any structure which would obstruct public view. However, the steamship company had erected docks on the property. Plaintiff condemned the property under a statute allowing condemnation of German property during World War 1. The parties agreed that plaintiff was exempt from taxation, but defendant contended that plaintiff did not own the property when the tax was imposed, because the taking was unconstitutional. Defendant's contention was rejected by the United States district court. However, the court observed that the conveyance had apparently been broken, and that apparently the state of New Jersey, which had originally conveyed the land to defendant, had a right of re-entry. (Hart-Florida)
W71-05203

AMERICAN TITLE AND TRUST CO V GULF REFINING CO (DISPUTE OVER LAND CONVEYED IN PATENT FROM ENGLISH CROWN).
72 F2d 248-251 (2d Cir 1934).

Descriptors: *Land tenure, *Boundaries (Property), *Islands, *Intertidal areas, High water mark, Low water mark, Shores, Boundary disputes, Real property, Beaches, Adjudication procedure, Judicial decisions, Legal aspects, New York.

Plaintiff landowner brough an action of ejectment against defendant landowner. Plaintiff claimed title to lands between high and low water marks on an island under a patent to his predecessor from the English Crown. The patent conveyed 'all Vacant and unappropriated Land and Meadow on Staten Island.' The Second Circuit Court of Appeals held that this description did not extend beyond the high water mark. Plaintiff offered to prove that the foreshore was geologically part of the island, but the court rejected the offer, since the grant was unambiguous. A governmental conveyance should not rest on implication, but appear expressly. Determining that the patent was not ambiguous so as to require extrinsic evidence to construe it, the court held that the patent had not conveyed the foreshore. (Hart-Florida)
W71-05204

SINCLAIR REFINING CO V BENNETT (POLLUTION OF WELLS BY GASOLINE LEAK).
123 F2d 884-887 (6th Cir 1941).

Descriptors: *Shallow wells, *Water pollution sources, *Gasoline, *Damages, Oil industry, Water pollution effects, Water pollution, Pollutants, Impaired water quality, Pollutant identification, Odor, Taste, Adjudication procedure, Legal aspects, Judicial decisions.

Plaintiff landowner sued defendant refining company for damages caused by gasoline pollution of plaintiff's wells. Defendant leased a gasoline filling station on contiguous premises. Gasoline leaked from a faulty pipe joint on one of defendant's gas tanks and soaked into the ground and into plaintiff's wells. Defendant contended that the evidence did not support the verdict and that the damages were excessive, since awarded for permanent rather than temporary injury. The Sixth Circuit Court of Appeals held that the evidence supported the verdict. Reviewing uncontradicted testimony that known gasoline-polluted wells had not become decontaminated for many years, and determining that the disputed wells still had a gasoline odor after 6 years, the court held that the lower court had properly awarded damages for permanent injury. (Hart-Florida)
W71-05207

COLE V AUSTIN (SUBMERGED FERRY CABLE AS OBSTRUCTION TO NAVIGATION).
140 A 108-114 (Conn 1928).

Descriptors: *Connecticut, *Navigable waters, *Navigation, *Boats, Islands, Piers, Riparian land, Riparian waters, Riparian rights, Public rights, Legal aspects, Judicial decisions.
Identifiers: Nuisance (Public).

In an action to quiet title to land, plaintiff riparian owner also sought to enjoin defendant from maintaining a ferry cable between defendant's island and the mainland. Plaintiff contended that the cable was a nuisance and an obstruction to navigation. Affirming a judgment for defendant, the court noted that a ferry cable does not obstruct navigation when, as in this case, it lay on the bottom and was only picked up by the ferry as it passed overhead. The court also noted that plaintiff had shown no special injury, different in kind from that suffered by the general public, and therefore could not maintain an action to enjoin a public nuisance. (Liptak-Florida)
W71-05213

MIDDLESEX WATER CO V BOARD OF PUBLIC UTIL COMM'RS (WATER COMPANY'S DUTY TO MAINTAIN WATER SUPPLY SYSTEM).

140 A 254-256 (NJ 1928).

Descriptors: *New Jersey, *Public utilities, *Water supply, *Water rates, Public utility districts, Water distribution (Applied), Pipelines, Water costs, Costs, Water conveyance, Municipal water, Administrative decisions, Legal aspects, Judicial decisions, Permits, Government finance, Income.

Plaintiff water company sought to reverse an order of defendant public utilities board requiring plaintiff to install certain water mains. Plaintiff contended that the new water lines would not be any more efficient or effective than the old line and that defendant erred in projecting the cost and income so that plaintiff was unable to raise the capital to carry out the order. Affirming defendant's order, the court noted that plaintiff was under a legal duty to maintain an adequate municipal water supply and could not excuse noncompliance with the board's order on the ground of financial inability. Plaintiff had just been granted two rate increases which provided a sufficient return on its capital. (Liptak-Florida)
W71-05217

IN RE WATER FRONT IN TOMPKINSVILLE (APPEAL OF CONDEMNATION AWARDS FOR SUBMERGED LANDS).
219 App Div 382, 220 NYS 18-23 (Sup Ct 1927).

Descriptors: *New York, *Easements, *Condemnation, *Condemnation value, Eminent domain, Compensation, Contracts, Judicial decisions, Legal aspects, State governments, Cities, Permits, Piers, Beds, Beds under water, Access routes.

Appellant municipality condemned respondent's submerged lands. The original condemnation award did not consider appellant's easement in the submerged lands; therefore, appellant sought a lesser award in this appeal. The New York supreme court held that appellant's easement should have been considered in making the award, noting that appellant's easement included right of passage over natural or artificial accretions. Appellant also contended that respondent's land was restricted to construction of public wharves and docks, but this contention was rejected, as was appellant's contention that the condemnation plan itself should affect the award. Covenants providing that respondents would in event of condemnation accept the amount paid to appellant originally, plus the value of any improvements, were held valid and enforceable. The court found that awards for consequential damages and conjunctive use were proper. Although respondents were not engaged in proper activities to obtain a license for shedding the piers, it was held that valuation on the theory that a license could be obtained was proper. Furthermore, the court determined that the ability of vessels to berth on both sides of the dock was properly considered in making the award. (Hart-Florida)
W71-05218

KORROLL V BOARD OF TRUSTEES OF SCHOOL DISTRICT 24 (BOUNDARY DISPUTE UNDER DESCRIPTION EXTENDING TITLE TO BANK OF LAKE).
220 NW 413-414 (Minn 1928).

Descriptors: *Minnesota, *Lakes, *Boundary disputes, *Accretion (Legal aspects), Riparian rights, Boundaries (Property), Real property, Land tenure, Riparian land, Judicial decisions, Legal aspects, Meanders, Land.

Plaintiff riparian landowner sought a declaratory judgment to determine title to a reliction in front of defendant's land. Defendant's deed described his land as extending 'along the bank of the lake.' Plaintiff owned riparian land on both sides of defendant. It was stipulated that the lake was meandered. Plaintiff contended that defendant held title only to the bank, rather than the waterline. Hence it was asserted that defendant had no claim in the reliction. However, the Supreme Court of Minnesota construed defendant's deed to convey title to the waterline and dismissed the action. (Hart-Florida)
W71-05219

EMMONS V UTILITIES POWER CO (CONDEMNATION VALUE OF OVERFLOWED LAND).
141 A 65-70 (NH 1928).

Descriptors: *New Hampshire, *Condemnation value, *Power head, *Flooding, Dams, Hydroelectric plants, Hydroelectric power, Eminent domain, Design flood, Backwater, Riparian land, Rivers, Compensation, Payment, Conjunctive use, Adjudication procedure, Judicial decisions, Legal aspects, Condemnation, Value.

Plaintiff riparian landowner brought action for assessment of damages to land overflowed by the backwater from defendant's dam. Since a 26-ft. power head was created by the river over the length of plaintiff's land, it was especially adaptable for production of water power. Plaintiff contended that the jury should consider conjunctive use of the power head in awarding damages, while defendant asserted that concomitant use should not be a factor in the award. The Supreme Court of Massachusetts stated that: (1) undeveloped water power is a property right inherent in riparian ownership, and therefore compensable; (2) the compensation should equal the diminution in value caused by the flowage; (3) the land should be appraised for its most profitable use; and (4) enhanced value because of conjunctive use may be shown if it would enhance the market price in an arm's length sale. The Supreme Court of New Hampshire held that the lower court erred in refusing to admit evidence of enhanced value caused by conjunctive use. Additionally, it was noted that: (1) special utility may be shown to enhance value; (2) the measure of damages is not the value to condemnor, but the value undeveloped and uncombined with other property; and (3) no rule exists for apportioning values of property capable of development in the aggregate as one unit. (Hart-Florida)
W71-05220

POLITICAL AND INSTITUTIONAL ASPECTS OF THE EVALUATION OF WATER RESOURCES PROGRAMS,
Wisconsin Univ., Madison.
Irving Fox.
In: Evaluation Processes in Water Resources Planning, Urbana, Illinois, American Water Resources Association, p 89-100, July 1970.

Descriptors: *Economic evaluation, Water resource planning, Water law, Decision-making, Cost-benefit analysis, Political constraint, Cost sharing.
Identifiers: *Water institutions, Shoreland management, Social cost, Social benefits.

Water institutions operating in a political context influence the evaluation process for water resources planning, and more specifically the weighting of information bears upon choices among alternative programs. Water institutions are divided into two categories; the laws, policies and programs that influence private enterprise in the water field and the public agencies that formulate water policy and provide water services to the private sector. The example of shoreland management is used to focus attention on private decision-making. A hypothesis is formulated which states that under present laws, shorelands, primarily privately owned, do not serve the public interest since social costs and benefits are not considered in decision-making. The hypothesis is found to be correct with public agencies involved in the environmental degradation of shorelands. The author finds water resource agencies do not represent all sectors of society equitably in policy making with special interest groups receiving the greatest benefits. Possible solutions to the problem include use of multiple alternatives in the evaluation process, greater integration in decision-making and more research on public goals. (Siegenthaler-Rutgers)
W71-05226

IN RE PUBLIC BEACH IN CITY OF NEW YORK (TITLE TO LANDS UNDER WATER).

256 NY 156, 176 NE 5 (1931).

Desriptors: *New York, *Boundaries (Property), *Land tenure, *Ownership of beds, High water mark, Land, Legal aspects, Judicial decisions, Real property, Condemnation, Eminent domain, Damages, Recreation, Cities, Local governments, State governments, Boundary disputes, Oceans, Beaches, Shores, Seashores.

Plaintiff city of New York sought to condemn certain upland property and offshore lands for a public beach. Defendants, by virtue of a colonial grant conveying to 'the main ocean,' claimed ownership of the upland to the high water mark. By virtue of a state conveyance, defendants claimed ownership of the offshore land from the high water mark to a distance of 1200 feet into the ocean. The trial court awarded only nominal damages to plaintiff for lands below high water mark. The appellata court reversed and the Court of Appears of New York affirmed for defendant. The colonial grant to the main ocean conveyed title to the high water mark. The later grant by the state to the land below the high water mark entitled defendant to damages for taking by plaintiff city. (Dye-Florida)
W71-05234

IN RE JAMAICA BAY (COMPENSATION FOR CONDEMNATION OF RIPARIAN RIGHT OF ACCESS).
256 NY 382, 176 NE 539-543 (1931).

Descriptors: *New York, *Riparian rights, *Condemnation, *Access routes, Compensation, Eminent domain, Navigation, Cities, Local governments, Governments, Riparian land, Land, Real property, Legal aspects, Judicial decisions, Navigable waters, Public rights, Relative rights, Docks, Land use, Landfills, Land reclamation, Land forming.

Plaintiff city condemned lands for construction of a marginal street along a bay shore. Defendant landowners sought compensation for destruction of their riparian right of access to the bay. The Court of Appeals of New York reversed in part a judgment denying compensation to defendants. Riparian rights are held subject to the public right to improve navigation and commerce. Riparian owners denied access to the bay by construction of a marginal street for such purposes are not entitled to compensation. However, where plaintiff sought to fill a creek for the purpose of building public streets, compensation must be awarded. In the instant case the city's purpose in condeming and filling some of the property was unclear. If it was

found that part of the fill was intended to be used for public purposes unrelated to navigation, compensation should have been awarded those landowners whose riparian rights were restricted by the fill. (Dye-Florida)
W71-05235

CARR V BANGHART (PRESCRIPTIVE RIGHTS IN STATE LAND).
170 A 620-622 (NJ Ct Err and App 1934).

Descriptors: *New Jersey, *Land tenure, *Canals, *Contracts, Legislation, State governments, Real property, Presciptive rights, Judicial decisions, Legal aspects, Land.

Plaintiff grantee sued defendant grantor for breach of covenant in a general warranty deed. Plaintiff asserted that a portion of the land conveyed by defendant belonged to the state. The disputed portion was part of an abandoned canal. In the legislation authorizing construction of the canal, the state reserved to itself the remainder after a term of years in the canal company. The company abandoned the canal early, but the state's right of possession did not accure until the term's expiration. Defendant, a mere interloper, 'appropriated' the land. Since defendant had not occupied the land for the period of the statute of limitations for adverse possession, running from the time the state's right to possession accrued, the state's title was upheld. Accordingly, the New Jersey Court of Errors and Appeals held defendant liable for breach of covenant. (Hart-Florida)
W71-05237

JENKINS V UNITED STATES (LIABILITY OF UNITED STATES FOR TAKING GRAVEL FROM SAND BAR).
60 Ct Cl 23-30 (1924).

Descriptors: *United States, *Mississippi River, *Compensation, *Dredging, Eminent domain, Condemnation, Payment, Administrative agencies, Navigation, Navigable rivers, Rivers, River beds, Sand bars, Banks, Bank erosion, Sands, Gravels, Channels, Channel erosion, Channel improvement, Riparian land, Riparian rights, Bank stabilization, Bank protection, Legal aspects, Judicial decisions.

Plaintiff riparian landowner sued defendant United States to recover the value of sand and gravel removed from an accretion to his land. Defendant had agreed when taking the gravel to make payment if liability attached. The gravel was used for bank protection at an entirely different location. Plaintiff contended that since the removal was not to improve navigability at that location, but solely to obtain the material, defendant must make compensation. Defendant asserted that its right to improve navigation was paramount to plaintiff's riparian ownership. The United States Court of Claims observed that since plaintiff conceded defendant's right to dredge the river to improve navigation without providing compensation, his argument was specious, because the right to compensation should not be determined by the utilization of the dredged material. Holding that plaintiff's ownership to the thread of the stream was subordinate to defendant's authority to improve navigation and that defendant's acts were not a compensable taking, the court dismissed plaintiff's petition. (Hart-Florida)
W71-05249

PREVENTION OF POLLUTION BY OIL AND HAZARDOUS MATERIALS IN MARINE OPERATIONS,
Coast Guard, Washington, D.C. Electrical Engineering Branch.
For primary bibliographic entry see Field 05G.
W71-05326

UNITED KINGDOM OIL INDUSTRY RESEARCH AND PLANS TO DEAL WITH SEA POLLUTION BY OIL,
Esso Petroleum Co. Ltd., London (England).
For primary bibliographic entry see Field 05G.
W71-05334

6F. Nonstructural Alternatives

WISE USE OF FLOOD PLAINS.
New England River Basins Commission, Boston, Mass.

Interim Report, July, 1969. 34 p, 2 fig, 5 tab, 1 chart, 1 append.

Descriptors: *New England, *Flood protection, *Non-structural alternatives, *Flood plain zoning, Flood plains, Flood damage, Flood forecasting, Floodproofing, Floodways, River basin development, Building codes, Flood plain insurance, Regions, Floods, Legislation, Governments, Cities, Urbanization, Community development, Land use, Regulation, Legal aspects.

As a result of increasing flood losses despite substantial flood protection measures, the New England River Basins Commission established a task force to study alternative measures of flood control. This report concentrates on non-structural methods of flood plain management and summarizes existing state and federal programs and policies. The basic problem is the clash between the rivers' natural tendency to flood the plain and the economic pressures to develop these areas. The solution is to prohibit or control this development by zoning and building controls. The report narrates the experience and status of such programs in each of the six New England states. These states have employed a variety of general and special laws, executive orders, local zoning ordinances, building codes, and land acquisition programs. The report also examines progress on 16 recommendations of a federal task force on the problem. The two basic areas of federal activity are assistance in flood plain delineation, surveying, and mapping, and actual assistance programs including a new flood insurance program. Finally, the report reviews the alternatives and assistance available to individual communities in planning and management of their flood plains. The report concludes that a concerted effort to fully use available planning tools is necessary to slow the rate of uneconomic and dangerous development of flood plains and to provide an optimum program for reducing flood losses. (Liptak-Florida)
W71-04994

FLOOD PLAIN INFORMATION OF RAPPAHANNOCK RIVER, FREDERICKSBURG, SPOTSYLVANIA AND STAFFORD COUNTIES, VIRGINIA.
Corps of Engineers, Norfolk, Va.
For primary bibliographic entry see Field 04A.
W71-05071

FLOOD PLAIN INFORMATION OF TOBESOFKEE CREEK, MACON AND BIBB COUNTY, GEORGIA.
Corps of Engineers, Savannah, Ga.
For primary bibliographic entry see Field 04A.
W71-05072

FLOOD PLAIN MANAGEMENT AND FLOOD INSURANCE,
James E. Goddard.
In: Evaluation Processes in Water Resources Planning, Urbana, Illinois, American Water Resources Association, p 58-74, July 1970.

Descriptors: *Flood plain insurance, Hydrology, Economic evaluation, Risk.
Identifiers: *Flood plain management, Resource planning, Subsidy, Suboptimization, Actuarial rates, Flood plain regulation.

The evaluation of flood plain regulations and possible alternative uses of flood plans based on site advantages is discussed. There are three general approaches to dealing with the flood plain; namely, flood protection, flood plain regulations and resource planning. The resource planning approach is involved with community goals and management opportunities and avoids problems of suboptimization. The Federally-assisted flood insurance program is described along with the land use and control measures. The author suggests refinements in Federal Flood Insurance to allow for true risk rates. Flood loss reimbursement rates offer a high subsidy for houses at low elevations but neglect commercial activities in the same area. The subsidy makes economic evaluation of the flood insurance program difficult since benefits and costs accrue to different parties. The author concludes that flood insurance is effective but offers little prospect for reform. (Siegenthaler-Rutgers)
W71-05223

PROBLEMS IN DEVELOPING A NATIONAL FLOOD-PROTECTION POLICY,
American Water Works Association, New York.
For primary bibliographic entry see Field 04A.
W71-05228

6G. Ecologic Impact of Water Development

MAN AND HIS ENVIRONMENT, VOLUME 1.
Calgary Univ. (Alberta).
For primary bibliographic entry see Field 05G.
W71-04901

FEDERAL PROTECTION OF ENDANGERED WILDLIFE SPECIES,
For primary bibliographic entry see Field 06E.
W71-04982

THERMAL EFFECTS STUDIES FOR PALISADES NUCLEAR PLANT,
Consumers Power Co., Jackson, Mich.
For primary bibliographic entry see Field 05C.
W71-05137

COUNCIL ON ENVIRONMENTAL QUALITY; STATEMENTS ON PROPOSED FEDERAL ACTION AFFECTING THE ENVIRONMENT.
For primary bibliographic entry see Field 06E.
W71-05180

THE QUALITY OF THE URBAN ENVIRONMENT,
California Univ., Los Angeles.
Harvey Perloff.
Baltimore, Johns Hopkins Press, 1969. 332 p.

Descriptors: *Urban environment, Pollution, Decision-making, Urban planning, Rent, Water resource development, Natural resources.
Identifiers: Material balance, Externalities, Congestion transport facilities.

The results of a conference on the Urban Environment held in 1967 are presented. The objective of the conference was to evaluate the existing information sources and new information that would be needed for measurement of environmental change and to study public policy issues related to environmental improvements. The main purpose was to present concepts useful to scholars and policy makers. The papers report on research in progress and are, therefore, essentially progress reports. The first paper attempts to set up a decision-making framework for policy making on the urban environment. The papers on pollution demonstrate the interrelation between waste product and the urban environment. Other papers deal with urban space on a two and three dimensional basis. This book is relevant for water resource planners concerned with the impact of government water investment

expenditures on the urban environment. (Siegenthaler-Rutgers)
W71-05214

SOCIAL SCIENCES AND THE ENVIRONMENT,
Colorado Univ., Boulder, and Environmental Science Services Administration, Washington, D.C.
For primary bibliographic entry see Field 06B.
W71-05245

ECONOMICS AND THE QUALITY OF THE ENVIRONMENT, SOME EMPIRICAL EXPERIENCES,
Resources for the Future, Washington, D.C.
For primary bibliographic entry see Field 06B.
W71-05246

07. RESOURCES DATA

7A. Network Design

NATIONAL AND INTERNATIONAL ENVIRONMENTAL MONITORING ACTIVITIES--A DIRECTORY.
Smithsonian Institution, Cambridge, Mass., Center for Short-Lived Phenomena.

For sale by Smithsonian Institution Center for Short-Lived Phenomena, 60 Garden Street, Cambridge, Mass. 02138 - Price $10.00. Smithsonian Institution Center for Short-Lived Phenomena, October 1970. 292 p.

Descriptors: *Environment, *Data collections, *Monitoring, *Networks, *Surveys, Meteorological data, Climatic data, Data transmission, International Hydrological Decade, Stations, Tsunamis, Hydrologic data, Weather data, Pesticides, Path of pollutants, Earthquakes, Radioactivity, Solar radiation, Hurricanes, Typhoons, Seismic studies, Fallout.
Identifiers: *Monitoring (Environmental), *Short-lived phenomena.

In 1968 the Smithsonian Institution utilized the techniques of modern communications to establish a world-wide monitoring system for short-lived natural events demanding immediate scientific investigation, such as volcanoes, earthquakes, meteorite falls and massive biological changes. Today, the Smithsonian Center for Short-Lived Phenomena has more than 2200 scientific correspondents in 129 countries and serves as the world's clearinghouse and repository for information concerning sudden, unpredictable, and short-lived events. The purpose of this directory is to present, in one unified format, basic information on the number, global distribution, and operational characteristics of existing and planned environmental monitoring activities. Questionnaires were sent to all known organizations and individuals engaged in environmental research, natural resource management, and pollution control on an international or national scale. A total of 2,332 organizations and individuals in 153 countries received questionnaires. (Knapp-USGS)
W71-05115

7B. Data Acquisition

SOIL MOISTURE DETECTION WITH IMAGING RADARS,
Kansas Univ., Lawrence. Remote Sensing Lab.
Harold C. MacDonald, and William P. Waite.
Water Resources Research, Vol 7, No 1, p 100-110, February 1971. 11 p, 7 fig, 22 ref. Contract DAAK02-68-C-0089 (THEMIS, Dept. ARMY); NASA Contract NAS9-10261.

Descriptors: *Soil moisture, *Remote sensing, *Radar, *Mapping, Surveys, Soil water, Soil classifications, Soil investigations, Soil physical properties, Soil types, Vegetation effects, Arctic, Permafrost.
Identifiers: *Radar (Imaging), *Radar (Side-looking).

The effects of soil moisture are extremely difficult to separate from other terrain parameters influencing the radar return signal. Presently available dual polarized, K-band, side-looking imaging radars provide a capability for revealing a qualitative estimate of soil moisture content. When used as a supplement to aerial photography in temperate climates, radar imagery analysis can provide data for mapping regions of permafrost, and this process caould be accomplished regardless of weather or time of day. (Knapp-USGS)
W71-04857

FLOW CELL SYSTEM FOR MISCIBLE DISPLACEMENT EXPERIMENTS,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 02G.
W71-04868

SINGLE-WELL TECHNIQUE USING P-32 FOR DETERMINING DIRECTION AND VELOCITY OF GROUNDWATER FLOW,
Middle Eastern Regional Radioisotope Center for the Arab Countries, Cairo, United Arab Republic.
For primary bibliographic entry see Field 02F.
W71-04878

A NEW METHOD OF DETECTING LEAKS IN RESERVOIRS OR CANALS USING LABELLED BITUMEN EMULSIONS (FRENCH),
CEA, Center of Nuclear Study of Grenoble, and Societe routiere Colas, Paris, France.
For primary bibliographic entry see Field 04A.
W71-04879

METHOD OF DETERMINING LEAKAGE VELOCITIES THROUGH THE BOTTOM OF RESERVOIRS,
Institute of Nuclear Physics, Cracow, Poland.
For primary bibliographic entry see Field 04A.
W71-04880

MODEL OF HYDROLOGIC REDISTRIBUTION OF RADIONUCLIDES AROUND NUCLEAR-EXCAVATED SEA-LEVEL CANALS,
Isotopes, Inc., Palo Alto, Calif. Palo Alto Labs.
For primary bibliographic entry see Field 05B.
W71-04882

CONTRIBUTION TO THE SELECTION OF RADIOACTIVE TRACERS FOR HYDROGEOLOGY (FRENCH),
Bureau of Geological and Mining Research (BRGM), Paris, France, and Commission of European Communities, Brussels, Belgium.
Andre Lallemand, and G. Grison.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/52, p 823-833, 1970. 11 p, 7 tab.

Descriptors: *Tracers, *Radioistopes, *Hydrogeology, Groundwater movement, Cesium, Tritium, Phosphorus radioisotopes, Carbon radioisotopes, Iodine radioisotopes, Clay minerals, Water chemistry, Water quality, Sea water, Spring waters, Sands.
Identifiers: Chromium radioisotopes, Iron radioisotopes, Calcium radioisotopes, Silver radioisotopes, Sodium radioisotopes, Cesium radioisotopes, Sulfur radioisotopes, Bromine radioisotopes.

A systematic study was made of a number of anionic and cationic tracers in different terrains with distinct petrographic characteristics, allowance being made for the various physical and chemical parameters of the environment. The behavior of 12 tracers (Cr-51, Fe-59, Ca-45, Ag-110, Na-24, Cs-137, H-3, P-32, S-35, C-14, I-131, Br-82) was studied in six types of argillaceous rock (illite, vermiculite, interstratified illite-vermiculite, montmorillonite, attapulgite and kaolinite) and three sand types (siliceous, Calcareous and dolomitic) in the presence of three types of water (demineralized, sea-water and various spring waters). On the basis of the results obtained from 5000 tests and measurements made during this study, selection tables are given for using the tracer most suited to the characteristics of the terrain and the type of groundwater. (Knapp-USGS)
W71-04883

RADON IN GROUNDWATERS OF DOLOMITIC AND CALCAREOUS AQUIFER IN APULIA (SOUTHERN ITALY),
CNEN, Laboratory for the Application of Radioisotopes to Hydrogeology, Bari, and Bari Univ., Italy.
For primary bibliographic entry see Field 02K.
W71-04884

SILICON-32 HYDROLOGY,
Tata Inst. of Fundamental Research, Bombay, India.
For primary bibliographic entry see Field 02K.
W71-04885

USE OF RARE-EARTH ELEMENTS AS TRACERS IN ESTUARIES,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02L.
W71-04886

HYDROLOGIC AND PHOTOGEOLOGIC DETERMINATION OF RAINFALL, RUNOFF, AND GROUNDWATER RELATIONSHIPS IN A DOLOMITE AREA,
Missouri Water Resources Research Center, Rolla; and Missouri Water Resources Research Inst., Rolla.
For primary bibliographic entry see Field 02A.
W71-04937

EVAPORATION LOSSES IN SPRINKLER IRRIGATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering; and Florida Univ., Gainsville. Water Resources Research Center.
For primary bibliographic entry see Field 02D.
W71-04938

PASSIVE MICROWAVE MEASUREMENTS OF SNOW, SOILS, AND OCEANOGRAPHIC PHENOMENA,
Aerojet-General Corp., El Monte, Calif. Space Div.
A. T. Edgerton, D. T. Trexler, G. A. Poe, A. Strogryn, and S. Sakamoto.
Available from NTIS as AD-714 855, $3.00 in paper copy, $0.95 in microfiche. Technical Report No 6, Feb 1970. 177 p, 94 fig. ONR NR 387-033.
Identifiers: *Snow, *Microwave spectroscopy, *Soils, Microwave spectroscopy, *Ocean waves, Microwaves Emissivity, Response Beaches, Sand, Surface roughness, Temperature, Brightness, Sedimentation, Sea ice, Salinity, Tables, Mathematical models, *Microwave radiometry, Littoral zones, Snowpack, Surf, Sea states, *Remote sensing.

Research consisted of a combination of field and laboratory investigations of the microwave emission characteristics of natural materials, and analytical modeling of the microwave radiation characteristics of selected materials to establish a better understanding of the physics of microwave emission. Field and laboratory investigations dealt with sediments, snow, ice, water and the coastal environment. Measurements were taken at observational wavelengths of 0.81 and 2.2 cm. Measurements of the littoral zone were taken to establish

the microwave emission characteristics of breakers, foaming water, spray, the swash zone, etc. High emissivities associated with foaming water in the surf zone prompted a laboratory experiment where foam was artificially generated and the microwave response monitored at 0.81 and 2.2 cm wavelengths as a function of percent of surface foam coverage. The results indicate that radiometric temperature depends strongly on the percentage of foam coverage and suggests that analytical models for predicting brightness temperatures of the open ocean must consider the percentage of surface covered by white caps. Laboratory measurements of the microwave response at 0.81 and 2.2 cm of fresh and sea water as a function of thermometric temperature show good agreement with emissivity values computed by investigators at Texas A and M University. The microwave emission characteristics of fresh and sea ice as a function if ice growth were investigated in the laboratory. Distinct differences in the response of fresh ice and sea ice are apparent during initial ice growth. Further measurements at longer wavelengths are indicated to fully evaluate the potential of microwave radiometry for distinguishing sea ice types. Additional research concerning emission characteristics of sediments was accomplished. This work was concerned with the relationship between moisture content and microwave emission. Experiments were conducted for two types of sediments. A beach sand water table fluctuation experiment was also performed.
W71-04942

THE MEASUREMENT OF WATER DEPTH BY REMOTE SENSING TECHNIQUES,
Michigan Univ., Ann Arbor. Inst. of Science and Technology.
F. C. Polcyn, W. L. Brown, and I. J. Sattinger.
Report No 8973-16-F, Oct 70. 48 p, 14 fig, 6 tab, 5 ref. ONR Contract No N62306-67-C-o243.
Identifiers: *Shallow water, Depth indicators, *Aerial photography, Sensors, Water waves, Refraction, Spacecraft cameras, Integral transforms, Programming (Computers), Digital computers, Data processing systems, Magnetic tape, Wave analyzers, Optical equipment, Lasers, Analysis of variance, Great Lakes, *Remote sensing Computer graphics, Fourier transformation, Lake Michigan.

The study demonstrates successful remote determination of shallow water depth by measuring wave refraction changes and using the Fourier transform plane for wavelength measurements with data obtained at a Lake Michigan test site. The study shows that the technique is suitable for use from spacecraft altitudes, provided that water waves of suitable length occur in the region of interest.
W71-04946

RESEARCH IN THE COASTAL AND OCEANIC ENVIRONMENT,
Delaware Univ., Newark.
For primary bibliographic entry see Field 02L.
W71-04950

PRIORITY PROBLEMS AND DATA NEEDS IN COASTAL ZONE OCEANOGRAPHY. EARTH OBSERVATION SATELLITE PLANNING,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 02L.
W71-04952

AUTOMATED METHOD FOR DETERMINING AND REMOVING SILICA INTERFERENCE IN DETERMINATION OF SOLUBLE PHOSPHORUS IN LAKE AND STREAM WATERS,
Guelph Univ. (Ontario). Dept. of Soil Science.
For primary bibliographic entry see Field 05A.
W71-04962

SPECIFIC CONDUCTANCE AS A MEANS OF ESTIMATING IONIC STRENGTH,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02K.
W71-04975

VERTICAL MOLECULAR DIFFUSION OF XENON-133 GAS AFTER INJECTION UNDERGROUND,
Geological Survey, Idaho Falls, Idaho.
For primary bibliographic entry see Field 05B.
W71-04977

RETENTION TIME AND CIRCULATION STUDY IN A SEWAGE STABILIZATION LAGOON,
Geological Survey, Raleigh, N.C.
For primary bibliographic entry see Field 05D.
W71-04978

ANOMOLY PATTERNS OF CLIMATE OVER THE WESTERN UNITED STATES, 1700-1930, DERIVED FROM PRINCIPAL COMPONENT ANALYSIS OF TREE-RING DATA,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
For primary bibliographic entry see Field 02B.
W71-05063

REMOTE SENSING OF HYDROLOGIC RESOURCES IN THE GREAT PLAINS, REPORT 1,
South Dakota State Univ., Brookings. Remote Sensing Inst.
F. A. Waltz, and V. I. Myers.
Available from NTIS as PB-195 451, $3.00 in paper copy, $0.95 in microfiche. Geological Survey Interagency Report USGS-202, June 1970. 60 p, 20 fig, 12 graph, 28 tab, 1 ref, 4 append. USGS Grant 14-08-0001-G-25.

Descriptors: *Remote sensing, *Satellites (Artificial), *Soil moisture, *Soil-water-plant relationships, Data processing, Data transmission, Photography, Soil properties, Infrared radiation, Statistical methods, Soil moisture meters, Microclimatology.
Identifiers: Soil moisture surveys.

A data handling system is proposed for measuring and disseminating cropland soil moisture information from ERTS spacecraft. Large significant correlations were found between optical density measured on aerial film and soil water content measured by neutron probe methods, and between ground temperatures as measured through infrared thermal scanner techniques and soil water content of fallow or bare soil. Least square analyses of variance indicated crop types, time, and the interaction of crops as highly significant sources of variation. Pattern recognition of different crops is possible using densitometry measurements if the extraneous variation can be controlled, measured, or removed. Soil water content, plant water content, and available soil water must be measured. (Knapp-USGS)
W71-05091

ON THE MICROSCOPIC DETERMINATION OF THE VOLUME SIZE DISTRIBUTION OF FINE-GRAINED SUSPENDED PARTICLES,
Johns Hopkins Univ., Baltimore, Md., Chesapeake Bay Inst.
J. R. Schubel, and E. W. Schiemer.
Limnology and Oceanography, Vol 14, No 3, p 438-441, May 1969. 4 p, 3 fig, 1 tab, 4 ref. Bureau of Commercial Fisheries Project 3-30-R.

Descriptors: *Filters, *Sieve analysis, *Particle size, *Suspended load, *Screens, Filtration, Silts, Plankton, Suspension, Sedimentology.
Identifiers: *Particle size analysis.

A multipass filtering apparatus costs less than $40.00, and it can be built in less than two days. The apparatus is loaded with a series of screens of different mesh size through which a measured volume of water is passed. Suitable screening material is available in mesh sizes ranging from 20 microns to more than 1,500 microns. Disks (47 mm) can be cut from the cloth easily. The series of mesh sizes most useful for analyzing the suspended particles of the Chesapeake Bay is 102, 53, 25, and 20 microns. Each of these screens is supported by a disk of 1,558 micron mesh cloth. In addition to its use to increase the precision of volume size statistics obtained from number size distributions, the multipass filtering apparatus is useful for fractionating samples of plankton. (Knapp-USGS)
W71-05107

NATIONAL AND INTERNATIONAL ENVIRONMENTAL MONITORING ACTIVITIES--A DIRECTORY.
Smithsonian Institution, Cambridge, Mass., Center for Short-Lived Phenomena.
For primary bibliographic entry see Field 07A.
W71-05115

AIRBORNE TEMPERATURE SURVEYS OF LAKE MICHIGAN, OCTOBER, 1966 AND 1967,
Michigan Univ., Ann Arbor. Great Lakes Research Div; and Naval Oceanographic Office, Washington, D.C.
V. E. Noble, and J. C. Wilkerson.
Limnology and Oceanography, Vol 15, No 2, March 1970, p 289-296. 7 fig, 6 ref.

Descriptors: *Lake Michigan, Isotherms, Infrared radiation, *Remote sensing, *Temperature, Lakes, *Water temperature.
Identifiers: *Airborne temperature surveys, *Thermal gradient, Satellite data.

Low-altitude flights to map surface water temperature were carried out over Lake Michigan on 18 October 1966 and 25 October 1967. During the 1966 flight, a strong surface water thermal gradient (4.4C/6,000 m) was observed. This gradient was accompanied by a distinct color change. Dynamic height currents computed from a bathythermograph transect through the gradient indicated a northward current of the order of 10-12 cm/sec in the gradient zone. The thermal structure persisted for a week. A similar temperature gradient-color separation-dynamic height current feature was observed during 1967. Data from Nimbus II meteorological satellite for 7 September and 6 October 1966 show a large, weak structure in the radiation temperature patterns that might be interpreted as precursors of the temperature-current structure. This thermal structure might be a recurring seasonal characteristic of Lake Michigan. (Upadhyaya-Vanderbilt)
W71-05120

GREAT LAKES THERMAL STUDIES USING INFRARED IMAGERY,
Department of Energy, Mines and Resources, Burlington (Ontario). Canada Center for Inland Waters.
R. K. Lane.
Limnology and Oceanography, Vol 15, No 2, March, 1970, p 296-300. 5 fig, 2 ref.

Descriptors: *Temperature, *Lake Ontario, Great Lakes, Infrared radiation, *Remote sensing, Lakes.
Identifiers: *Thermal studies, Infrared imagery, Thermal bar, Airborne thermometry.

During spring to autumn, 1968, seven airborne surveys of western Lake Ontario were made with an infrared scanner. The sensor of the infrared scanner repeatedly scans a path normal to flight across a 120 deg field of view detecting electromagnetic radiation in the 8-14 micron band. Spatial resolution is 16 m radians and thermal resolution is estimated at 0.01C. Examples of mosaics of infrared imagery of the western end of Lake Ontario are used to demonstrate their value in revealing detailed surface thermal patterns. Ad-

ditional data from airborne thermometry and shipboard measurements confirm the interpretation of large scale dynamic processes. Smaller scale phenomena such as internal wave patterns and small eddies, are also interpretable. The problem of dealing with the attenuation effects of the atmosphere is more difficult, particularly since the scanner views through a path length that changes by a factor of 2 as it sweeps from nadir to 60 deg. The use of atmospheric profile data, the air-water temperature difference, and a narrower band detector offers the possibility for more quantitative data. (Upadhyaya-Vanderbilt)
W71-05123

FLOOD PLAIN DELINEATION WITH PAN AND COLOR,
Wisconsin Univ., Madison. Department of Soil Science.
Dale E. Parker, Gerhard B. Lee, and Clarence J. Milfred.
Reprint, Photogrammetric Engineering, p 1059-1063, October 1970. 3 fig, 7 ref. OWRR B-002-WIS (12).

Descriptors: *Flood plains, Color, *Aerial photography, Glaciation, Cross-sections, *Hydrologic data, Wisconsin, Photogrammetry, *Boundaries (Surfaces), Photography.
Identifiers: Delineation, Panchromatic photography, Physiographic landforms, Southern Wisconsin, Flood plain boundaries.

Boundaries of rare floods, such as a 100-year recurrence interval flood which is widely used for planning and regulatory purposes, are ordinarily plotted by engineering procedures. In this study flood plain boundaries were interpreted on panchromatic, and color aerial photographs along a stream in a glaciated area of southern Wisconsin. The accuracy of these boundaries was determined by comparison at 29 cross sections with those of an Intermediate Regional Flood plotted by the U. S. Army Corps of Engineers. Boundaries on both types of photography agreed with the engineering boundary at 28 percent of the cross sections, were within 100 feet at 67 percent of the cross sections, and within 300 feet at 95 percent of the cross sections. Flood plain boundaries were most accurately delineated where physiographic landforms were well defined. The results indicate that airphoto interpretation can be a useful tool to delineate flood plain boundaries where the lack of hydrologic data, time, and funds prohibit plotting boundaries by traditional engineering methods. (Parker-Wisconsin)
W71-05145

HYDROLOGIC INTERPRETATION OF NIMBUS VIDICON IMAGE - GREAT SALT LAKE, UTAH,
Geological Survey, Washington, D.C.
D. C. Hahl, and A. H. Handy.
Available from NTIS as N70-38843, $3.00 in paper copy, $0.95 in microfiche. Technical Letter NASA-61, Nov 1966. 3 p. NASA Contract R-09-020-015.
Identifiers: *Hydrology, *Nimbus satellites, *Photointerpretation, *Satellite television, Utah, Vidicons.

The analysis was made to determine if features of hydrologic significance were visible and identifiable. The features that are pointed out on an annotated copy of the image indicate some of the factors that are required to produce an image. Vegetation and geology may be responsible for the delineation or lack of delineation of some features. Depth is not considered a factor in producing an image. The implications of using the Advanced Vidicon Camera System in the field of hydrology are assessed.
W71-05152

APPLICATION OF METHOD FOR PREDICTING THERMAL ERROR IN MEASUREMENT OF GROUND TEMPERATURE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 02C.
W71-05257

PHOTOGRAPHIC EVALUATION OF WATER WELLS,
Layne Texas Co., Inc., Houston.
Owen F. Jensen, Jr., and William Ray.
Reprint, Presented at the SW Section of AWWA 53rd Annual Conference, 1964. 20 p.

Descriptors: *Water well, *Wells, Casing, Photography, Remote sensing.
Identifiers: *Downhole photographs, Well condition evaluation, New well completions, Damaged wells, Junk in wells, Formation identification.

Photographs of wells in stereoscopic, three dimensional pairs, are used for evaluation of well conditions. The pictures provide accurate detail pictures from which determination can be made for remedial procedures or for inspection of a well from top to bottom. These stereoscopic photograph surveys are used for evaluation of new well completions, damaged well, junk in wells, and formation material identification. Incorporated in this paper are pictures of the groups made in wells. (Campbell-NWWA)
W71-05299

7C. Evaluation, Processing and Publication

NUMERICAL SIMULATION OF FLOOD WAVE MODIFICATION DUE TO BANK STORAGE EFFECTS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W71-04854

A COMPARATIVE STUDY OF CRITICAL DROUGHT SIMULATION,
California Univ., Los Angeles. Dept. of Engineering Systems.
For primary bibliographic entry see Field 04A.
W71-04861

A SIMULATION MODEL OF A COMPLEX RECURVED SPIT,
Nottingham Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 02J.
W71-04870

COMPARISON OF HYDROLOGICAL AND MATHEMATICAL METHODS IN ANALYSIS OF TRITIUM DATA,
Federal Experimental and Research Institute Arsenal, Vienna, and Technical High School, Vienna, Austria.
R. Konig, and J. Reitinger.
In: Isotope Hydrology, 1970, Proceedings Symposium of International Atomic Energy Agency and UNESCO, Vienna, March 9-13, 1970: Vienna, International Atomic Energy Agency STI/PUB/255, Paper No SM-129/50, p 787-800, 1970. 14 p, 4 fig, 8 ref.

Descriptors: *Sampling, *Tritium, Tracers, Hydrogeology, Statistical methods, Optimization, Groundwater movement, Water yield, Springs, Discharge (Water), Water balance, Water resources, Water resources development, Groundwater basins.
Identifiers: *Vienna (Austria).

Many tritium samples were recently taken in boreholes, springs and groundwater overflows in the southern Vienna Basin, Austria. The data were analyzed to determine whether the tritium data confirm existing hydrological models, whether the tritium data give new information about the hydrology of this region, and the proper number of samples and frequency of sampling. These questions are treated using statistical mathematical methods. The measured time series (isotopic data) are random samples. Statistical methods give optimum values for the time interval for sampling and the total time of sampling. (Knapp-USGS)
W71-04881

A COMPUTER-ORIENTED GENERALIZED POROSITY-LITHOLOGY INTERPRETATION OF NEUTRON, DENSITY AND SONIC LOGS,
Gulf Research and Development Co., Pittsburgh, Pa.
Martin H. Harris, and R. B. McCammon.
Journal of Petroleum Technology, p 239-248, February 1971. 10 p, 6 fig, 4 tab, 9 ref.

Descriptors: *Radioactive well logging, *Data processing, *Borehole geophysics, Stratigraphy, Porosity, Permeability, Density, Computers, Computer programs, Subsurface investigations.
Identifiers: *Sonic well logging, *Well log interpretation.

The linear bulk volume response equations for neutron, density and sonic logs are formulated to simultaneously determine porosity and lithology in sand-shale as well as carbonate lithologies. A fundamental problem in solving the response equations, that of the existence of nonunique solutions, is resolved. Nonunique solutions arise because the number of lithology and porosity terms that must be considered exceeds the number of response equations. The validity of the generalized equations and the minimum variance technique for resolving nonunique solutions is illustrated. (Knapp-USGS)
W71-04889

FLOOD HAZARD INFORMATION, ROSE CANYON AND SAN CLEMENTE CANYON, CITY OF SAN DIEGO, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W71-04904

FLOOD PLAIN INFORMATION, HATCHIE RIVER, PLEASANT RUN CREEK AND SPRING CREEK, BOLIVAR, TENNESSEE.
Corps of Engineers, Memphis, Tenn.
For primary bibliographic entry see Field 04A.
W71-04905

PROGRAM OF THE WATER RESOURCES DIVISION, TEXAS DISTRICT, FOR THE 1971 FISCAL YEAR AND SUMMARY OF DISTRICT ACTIVITIES DURING FISCAL YEAR 1970.
Geological Survey, Austin, Tex. Water Resources Div.

Geological Survey Information Bulletin, December 1970. 34 p, 1 map.

Descriptors: *Water resources, *Programs, *Project planning, *Reviews, *Texas, Surface water, Groundwater, Publications, Bibliographies, Hydrologic data, Streamflow, Runoff, Water yield, Gaging stations, Lakes, Reservoirs, Geology, Data collections, Projects, Project purposes, Aquifers, Water levels.
Identifiers: *Hydrologic data summary (1970 FY Tex), *Data collection plans (1971 FY Tex).

The program of the Water Resources Division in Texas consists of the collection of basic records through the hydrologic-data network, interpretive studies, and research. The basic-data records and the results of investigations are published by the Geological Survey or by cooperating agencies. This report summarizes the scheduled activities of the Water Resources Division in Texas for the fiscal year (July 1, 1970 to Jun 30, 1971) and district activities during fiscal year 1970 (July 1, 1969 to

June 30, 1970). A significant activity in the Texas District is the collection of basic hydrologic data. Continuing series of measurements are made of streamflow, reservoir contents, chemical quality of water, sediment in streams and reservoirs, water levels in wells, and land-surface subsidence. Modern computer techniques are being used successfully in the collection and publication of water data. By the end of the 1971 fiscal year, the following installations will be in operation: Approximately 220 digital recorders at stream-gaging stations; 20 conductivity recorders; and one instrument for continuously and simultaneously monitoring and recording the water-quality characteristics of conductivity, water temperature, dissolved oxygen and pH. The use of electronic data processing for printing and storing water records will be expanded. (Woodard-USGS)
W71-04906

MATHEMATICAL MANAGEMENT MODEL--UNCONFINED AQUIFER,
Texas Tech Univ., Lubbock. Water Resources Center; and High Plains Underground Water Conservation District No. 1, Lubbock, Tex.
For primary bibliographic entry see Field 02F.
W71-04931

EVALUATION OF THE STREAMFLOW DATA PROGRAM FOR ARKANSAS,
Geological Survey, Little Rock, Ark.
James L. Patterson.
For sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1970, Chapter D, Professional Paper 700-D, p D244-D256, 1970. 13 p, 1 fig, 5 tab, 8 ref.

Descriptors: *Data collections, *Streamflow, *Arkansas, *Hydrologic data, Streamflow forecasting, Peak discharge, Low flow, Floods, Stage-discharge relations, Stream gages, Gaging stations, Networks, Hydrology, Sedimentation, Planning, Evaluation, Discharge (Water).
Identifiers: Streamflow data.

An evaluation of the streamflow data available in Arkansas was made to provide guidelines for planning. The basic steps in the evaluation procedure were (1) definition of the long-term goals of the streamflow data program in quantitative form, (2) examination and analysis of available data to determine which goals have already been met, and (3) consideration of alternate programs and techniques to meet the objectives. Since many of the goals could be met by generalization of the data for gaged basins by regression analysis, significant changes could be made in the data program that would allow emphasis to be placed on attaining the goals that have not been met. A streamflow data program based on the guidelines developed in this study is proposed. (Knapp-USGS)
W71-04974

WATER RESOURCES OF THE GREAT SMOKY MOUNTAINS NATIONAL PARK, TENNESSEE AND NORTH CAROLINA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W71-04979

FLOOD OF MARCH 1968 ON THE SUDBURY, ASSABET, AND CONCORD RIVERS, MASSACHUSETTS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W71-04980

FLOOD OF JUNE 1967 AT GRAND ISLAND, NEBRASKA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W71-04981

ANNUAL COMPILATION AND ANALYSIS OF HYDROLOGIC DATA FOR MOUNTAIN CREEK, TRINITY RIVER BASIN, TEXAS, 1969,
Geological Survey, Austin, Tex. Water Resources Div.
H. D. Buckner.
Geological Survey Report, January 1971. 9 p, 1 fig.

Descriptors: *Streamflow, *Flow measurement, *Data collections, *Gaging stations, *Reservoir stages, Texas, Surface waters, Hydrologic data, Flow rates, Average flow, Low flow, Peak discharge, Lakes.
Identifiers: *Trinity River basin (Tex), Basic data, Flow extremes.

Streamflow data for 3 gaging stations and reservoir contents for one lake in the Trinity River basin, Texas, are tabulated for the 1969 water year (October 1, 1968 to September 30, 1969). The stations include Mountain Creek near Cedar Hill, Walnut Creek near Mansfield, Mountain Creek at Grand Prairie and Mountain Creek Lake near Grand Prairie. Pertinent information concerning historic and current hydrologic data are included in the table headings. Basin outflow for the 1969 water year was 145,400 acre-feet. Storage in Mountain Creek Lake showed a net increase of 2,850 acre-feet during the water year. Rainfall over the study area for the 1969 water year was about 33 inches, which is about 1 inch below the long-term mean for the area. (Woodard-USGS)
W71-05049

MASS, MOMENTUM, AND ENERGY BUDGET EQUATIONS FOR BOMAP COMPUTATIONS,
National Oceanic and Atmospheric Administration, Rockville, Md., The BOMAP Office.
For primary bibliographic entry see Field 02A.
W71-05052

RECORDS OF WATER-LEVEL MEASUREMENTS IN WELLS IN GALVESTON COUNTY, TEXAS, 1894-1969.
Geological Survey, Houston, Tex.

Published and distributed by the Texas Water Development Board, P O Box 13087 Austin, Tex 78711. R. K. Gabrysch, Gene D. McAdoo, and C. W. Bonnet, compilers. Texas Water Development Board Report 123, December 1970. 100 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Water levels, *Groundwater, *Observation wells, *Data collections, Texas, Hydrologic data, Water level fluctuations, Aquifers, Wells, Depth.
Identifiers: *Galveston County (Tex).

Measurements in most observation wells in Galveston County, Texas, are made annually, but some measurements are made monthly, quarterly, or semiannually. A continuous measurement record is obtained at two locations where water-stage recorders are installed. If numerous measurements in a well were made during a short period of time, or if water-level data were obtained from a water-stage recorder, representative water levels were selected for publication. Water levels are referenced to land-surface datum. (Woodard-USGS)
W71-05069

RECORDS OF WATER-LEVEL MEASUREMENTS IN WELLS IN HARRIS COUNTY, TEXAS, 1966-1969.
Geological Survey, Houston, Tex.

Published and Distributed by the Texas Water Development Board, P O Box 13087, Austin, Tex 78711. R. K. Gabrysch, C. W. Bonnet, and W. L. Naftel, compilers. Texas Water Development Board Report 122, November 1970. 65 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Water levels, *Groundwater, *Observation wells, *Data collections, *Texas, Hydrologic data, Water level fluctuations, Aquifers, Wells, Depth.
Identifiers: *Harris County (Tex).

This report is the second in a series of reports prepared by the U. S. Geological Survey in cooperation with the Texas Water Development Board and the city of Houston on water-level measurements in Harris County, Texas. Measurements in most observation wells are made annually, but some measurements are made monthly, quarterly, or semiannually. A continuous measurement record is obtained at five locations where water-stage recorders are installed. If numerous measurements were obtained from a water-stage recorder, representative water levels were selected for publication. (Woodard-USGS)
W71-05070

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1965, PARTS 12-16.
Geological Survey, Washington, D.C.

For sale by Superintendent of Documents, U.S. Government Printing Office, Wash, D.C. Price - $2.00. Geological Survey Water-Supply Paper 1966; 1970. 462 p, 1 fig, 32 ref.

Descriptors: *Water quality, *Surface waters, *Data collections, *Water analysis, *Pacific Northwest U.S., Alaska, Hawaii, Sediment transport, Sediment yield, Sediment load, Particle size, Water temperature, Water properties, Water chemistry, Chemical analysis.
Identifiers: *Basic data (Surface-water quality).

This volume includes data on quality of surface waters in Northwestern conterminous United States, Alaska, and Hawaii for the 1965 water year (October 1, 1964 to September 30, 1965). The Geological Survey maintained 206 stations on 155 streams. Samples were collected daily and monthly at 67 of these locations for chemical-quality studies. Samples also were collected less frequently at many other points. Water temperatures were measured continuously at 126 and daily at 36 stations. Quantities of suspended sediment are reported for 35 stations from samples collected one or more times daily. Particle-size distributions of sediments were determined at 41 stations. Descriptive statements are given for each sampling station including location of the station, drainage area, periods of records available, extremes of dissolved solids, hardness, specific conductance, temperature, sediment loads, and other pertinent data. Records of discharge of the streams at or near the sampling station are included in most tables of analyses. (Woodard-USGS)
W71-05089

SURFACE WATER SUPPLY OF THE UNITED STATES, 1961-65: PART II. PACIFIC SLOPE BASINS IN CALIFORNIA - VOLUME I.
Geological Survey, Washington, D.C.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Wash, D.C. 20402 - Price $2.75. Geological Survey Water-Supply Paper 1928, 1970. 501 p, 3 fig, 1 plate.

Descriptors: *Surface waters, *Flow measurement, *Hydrologic data, *Gaging stations, *California, Data collections, Streamflow, Lakes, Reservoir stages, Runoff, Discharge measurement, Average flow, Low flow, Peak discharge.
Identifiers: *Pacific slope basins (Calif).

This volume which contains hydrologic data of basins from Tia Juana River to Santa Maria River in California, is one of a series of 37 reports presenting records of stage, discharge, and content of streams, lakes, and reservoirs in the United States during the 1961-65 water years. The tables of data include a description of the gaging station, and daily, monthly, and yearly discharges of the stream. The description of the station gives the location drainage area, records available, type and history of gage, average discharge, extremes of discharge, and general remarks. For most gaging stations on lakes and reservoirs, a description of the

station and a monthly summary table of stage and contents are given. Data for partial-record stations include discharge measurements at low-flow partial-record stations, and annual maximum stage and discharge at crest-stage stations. (Woodard-USGS)
W71-05090

ELECTRICAL-ANALOG-MODEL STUDY OF WATER RESOURCES OF THE COLUMBUS AREA, BARTHOLOMEW COUNTY, INDIANA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W71-05092

THE STREAMFLOW DATA PROGRAM IN IOWA - EVALUATION OF THE PAST, PROPOSAL FOR THE FUTURE,
Geological Survey, Iowa City, Iowa.
Ivan L. Burmeister.
Geological Survey Open-file Report, 1970. 82 p, 10 fig, 8 tab, 15 ref, append.

Descriptors: *Streamflow, *Hydrologic data, *Programs, *Project planning, *Iowa, Water resources, Surface waters, Gaging stations, Stream gages, Data collections, Discharge measurement, Flow characteristics, Average flow, Frequency analysis, Precipitation (Atmospheric), Runoff, Flow rates, Regression analysis, Network design, History, Natural flow, Regulated flow, Streams, Temperature.
Identifiers: *Streamflow data (Iowa).

The streamflow data program in Iowa was evaluated on the basis of past records and present goals and needs. Many of the goals could be met by generalization of the data for gaged basins by regression analysis. Estimates of mean annual and monthly discharges, flood-volume and peak discharges of 5-year frequency or greater can be made within the accuracy equivalent to 10 years of record. Mean annual and 7-day 50-year flood volume discharges can be estimated within the accuracy equivalent of 25 years of record. Significant changes could be made in the present data program that would allow emphasis to be placed on attaining the goals that have not been met. Contingent upon mutual agreement with cooperating agencies, the Iowa District proposes discontinuing 33 of the 119 continuous-record streamflow stations and establishing 8. An updated program of data collection and analysis is proposed. (Woodard-USGS)
W71-05093

HYDROLOGIC REGIMEN OF WALKER LAKE, MINERAL COUNTY, NEVADA,
Geological Survey, Washington, D.C.
F. Eugene Rush.
For sale by US Geological Survey, Washington, DC 20242-Price $1.00. Geological Survey Hydrologic Investigations Atlas HA-415, 1 sheet, 1970. Text, 7 fig, 1 tab, 15 ref.

Descriptors: *Lake morphology, *Water levels, *Water level fluctuations, *Hydrologic data, *Hydrologic budget, *Nevada, Droughts, Precipitation (Atmospheric), Streamflow, Runoff, Water yield, Water quality, Dissolved solids, Water utilization, Recreation, Water conservation, Evaporation, Water balance.
Identifiers: *Walker Lake (Nev), Water budget.

Walker Lake is about 60 miles southeast of Carson City, Nev. The town of Hawthorne, Nev., is near the south end of the lake. The lake is used principally for boating, water skiing, and fishing. However, there is considerable concern for the future of the lake because of its rapid stage recession. The altitude of the lake's surface has receded from about 4,083 feet in 1882 to 3,970 feet in 1968 and the surface area has decreased from nearly 69,000 acres to 38,000 acres. The maximum depth in 1968 was about 118 feet. At the present rate of recession, the lake may not reach new equilibrium until the lake level recedes another 70 feet, at which time the area might be approximately 25,000 acres and the depth 40 feet. The purpose of this report is (1) to define the area and volume configurations of the lake and (2) to show the effects of recession processes on lake stage, area, volume, and dissolved-solids content. This one-sheet atlas includes a hydrologic regimen map (scale 1:62500) of Walker Lake and eight related tables and illustrations. (Woodard-USGS)
W71-05095

AVERAGE ANNUAL PRECIPITATION AND RUNOFF IN NORTH COASTAL CALIFORNIA,
Geological Survey, Washington, D.C.
S. E. Rantz.
For sale by US Geological Survey, Washington, DC Price 75 cents. Geological Survey Hydrologic Investigations Atlas HA-298, 1968. Text, 1 fig, 4 map, 1 tab, 19 ref.

Descriptors: *Rainfall-runoff relationships, *Hydrologic data, *Maps, *Water resources, *California, Evapotranspiration, Regression analysis, Mathematical studies, Streamflow, Flow rates, Water yield, Runoff, Rainfall, Hydrology, Hydrologic cycle, Vegetation effects, Distribution patterns, Average, Annual, Seasonal, Precipitation (Atmospheric), Drainage systems.
Identifiers: *California (North Coastal), *Hydrologic atlas, Drainage area.

This report consisting of a hydrologic atlas of 4 maps on I sheet and a separate text, presents average annual precipitation, annual precipitation, and runoff in California coastal basins north of San Francisco Bay, and demonstrates a close relation between average annual runoff and average annual precipitation and potential evapotranspiration. Multiple linear regression equations relating these elements are derived for each of the two physiographic sections or subregions in the study area--the Coast Ranges and the Klamath Mountains. The study area includes about 17,000 square miles. The principal streams are the Russian, Eel, Mad, Klamath, and Smith Rivers, all of which drain large interior basins. Most of the other streams in the region drain only the coastal slope of the Coast Ranges. The map showing principal drainage systems and hydrologic units delineates the systems and those units under consideration for project planning. Average annual runoff in the study area totals about 31 million acre-feet, which is the equivalent of about 34 inches of water over the entire area. The long-term basinwide averages range from 7 to 90 inches. (Woodard-USGS)
W71-05096

WATER RESOURCES OF THE WILD RICE RIVER WATERSHED, NORTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
T. C. Winter, L. E. Bidwell, and R. W. Maclay.
For sale by US Geological Survey, Washington, DC 20402 - Price $2.00 per set. Geological Survey Hydrologic Investigations Atlas HA-339, 4 sheets, 1970. Text, 25 fig, 18 map, 5 tab, 6 ref.

Descriptors: *Water resources development, *Surface waters, *Groundwater, *Hydrologic data, *Minnesota, Water resources, Surface-groundwater relationships, Precipitation (Atmospheric), Streamflow, Runoff, Hydrogeology, Aquifers, Aquifer characteristics, Water yield, Water quality, Floods, Water utilization, Consumptive use, Water pollution control, Hydrology.
Identifiers: *Wild Rice River basin (Northwestern Minn).

This hydrologic atlas contains 4 sheets (approximately 42x46 inches each) of hydrologic data shown in maps, tables, graphs, and illustrations concerning water resources of the Wild Rice River watershed in Northwestern Minnesota. The annual mean runoff of the entire Wild Rice River watershed is about 1.8 inches or 250,000 acre-feet. Flooding along the lower Wild Rice, Marsh, and Sandhill Rivers is caused by flat land surface, small capacity channels, and low gradient of the channels in the lake plain. The natural streamflow of the Red River of the North is inadequate for a dependable water supply and pollution abatement in the river. Streamflow is supplemented by release of stored water from Orwell Reservoir on the Ottertail River and from Lake Ashtabula on the Sheyenne River in North Dakota. The area with best potential for large yield wells is the outwash and ice-contact sand and gravel in the eastern part of the watershed. Calcium magnesium bicarbonate, the most common water type in the area, occurs mainly in the central and eastern part of the watershed. (Woodard-USGS)
W71-05113

WATER RESOURCES OF THE RED LAKE RIVER WATERSHED, NORTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
L. E. Bidwell, T. C. Winter, and R. W. Maclay.
For sale by US Geological Survey, Washington, DC 20402 - Price $2.00 per set. Geological Survey Hydrologic Investigations Atlas HA-346, 4 sheets, 1970. Text, 26 fig, 16 map, 6 tab.

Descriptors: *Water resources development, *Surface waters, *Groundwater, *Hydrologic data, *Minnesota, Streamflow, Runoff, Precipitation (Atmospheric), Hydrogeology, Aquifers, Aquifer characteristics, Water yield, Water quality, Water utilization, Consumptive use, Water resources, Planning, Hydrology, Hydrologic cycle, Floods.
Identifiers: *Red Lake River Basin (Northwestern, Minn).

This hydrologic atlas contains 4 sheets (approximately 42x46 inches each) of hydrologic data shown in maps, tables, graphs, and illustrations concerning water resources of the Red Lake River watershed in Northwestern Minnesota. The hydrologic system within the Red Lake River basin is described and analyzed from a regional viewpoint. It is concluded that any large scale development of water supply within the basin would require additional structural measures to store water either on the land surface or within the groundwater reservoir by using the natural storage capacity of aquifers. The latter alternative would require much more information on the storage capacity of the groundwater reservoir in the particular place of development. Flooding is a major problem within the flat areas of the watershed but measures for considerable control have been completed. In its natural condition the watershed is ideally suited for wildlife propagation throughout much of its eastern part. Potential for water-based recreation is large in the morainal and Upper and Lower Red Lake area. Water supply is a particular problem in the western, highly developed agricultural area of the watershed. (Woodard-USGS)
W71-05114

08. ENGINEERING WORKS

8A. Structures

CONTROL OF WATER POLLUTION DURING DAM CONSTRUCTION,
California State Dept. of Water Resources, Sacramento; and Santa Ana Regional Water Quality Control Board, Riverside, Calif.
For primary bibliographic entry see Field 05G.
W71-04888

LABORATORY LOAD TESTS ON BURIED FLEXIBLE PIPE,
Bureau of Reclamation, Denver, Colo. Office of Chief Engineer.
Amster K. Howard.
Available from NTIS as PB-195 773, $3.00 in paper copy, $0.95 in microfiche. Bureau of Reclamation Report No REC-OCE-70-24, June 1970. 72 p, 4 tab, 43 fig, 5 ref.

Descriptors: *Pipelines, Backfill, Soil mechanics, Cohesive soils, Test procedures, Underground structures, Research and development, Laboratory tests, Pressure measuring instruments, *Soil pressure, Pressure sensors, Strain gages, Embankments, Lateral forces, *Steel pipes, Pipes, Strain, Deflection, Deformation, Settlement (Structural).
Identifiers: *Flexible pipes, *Buried pipes, Pressure cells, Loading tests, Iowa Formula, Soil-structure interaction.

In an effort to lower construction costs of closed conduit systems, the Bureau of Reclamation has been investigating the soil-structure interaction of buried flexible pipe. The test pipes are buried in a large container by placing a lean clay soil at optimum moisture around and over the pipe at 90% maximum dry density. Surcharge loads are applied with a universal testing machine. Measurements of soil pressures on the pipe and soil container walls, changing dimensions of the pipe, soil movement around the pipe, and strain on the inner surface of the pipe are made during a 1-day loading sequence. Deflection data from 5 tests reported earlier and 4 additional tests showed good correlation with the Iowa Formula for flexible pipe design. The deformed shape of the pipe ranged from elliptical to rectangular, depending on the ring stiffness of the pipe. One pipe failed by elastic buckling at 8% vertical deflection. Plastic hinges formed in the other pipe between 16 and 22% vertical deflection.
W71-04954

A SYSTEMS STUDY OF SOFT GROUND TUNNELING,
Fenix and Scisson, Inc., Tulsa, Okla; and Little (Arthur D.) Inc., Cambridge, Mass.
C. T. Brandt, R. B. Stone, A. R. Smith, B. H. Willis, and Alex Pastuhof.
Available from NTIS as PB-194 769, $3.00 in paper copy, $0.95 in microfiche. Final Report DOT-FRA-OHS-GT-231, May 1970. 486 p, 3 fig, 15 tab, 266 ref. DOT-FR-9-0034.
Identifiers: *Tunnels, *Subsurface investigations, Subways, Tunneling, Excavation, Underground surveys, Shields, Tunneling, Underground supporting, Tunnel linings, Shotcrete, Reinforced concrete, Soil analysis, Construction equipment, Construction materials, Construction costs, Cost comparison, Systems analysis, *Soft ground tunneling, Advanced planning.

A fundamental investigation of soft-ground tunneling operations was made to identify and assess the potential technical and economic feasibility of new tunneling system concepts. Quantitative estimates were made of costs and rate of advance of different candidate system concepts relative to an assumed set of tunneling conditions. The magnitude of R and D effort required to achieve cost reductions and performance improvements over the 1970 to 1985 time period was estimated. The study concludes that the major restraints to reducing costs and increasing performance in soft ground tunneling over the 1970 to 1985 time period will result from the lack of any effective method for handling bouldery ground and from the lack of a method for rapid installation of the permanent tunnel liner continuously and concurrently with the advance of the face. With a 15-year R and D effort of $35 to $70 million, these problems could be substantially overcome and current tunneling costs could be expected to decrease by 40-65% and advance rates could be expected to increase by a factor of from 4 to 8. Cost differences among the more promising alternative system concepts were found to be small relative to the range of uncertainty associated with the cost forecasts. The most promising areas of new technology were judged to be the dredgehead for excavation; soil-water balance, air-on-face, synthetic resins, and cryogenic freezing for ground control; modular vehicle and hydraulic pipeline for materials handling; and shotcrete and fast setting poured-in-place concrete for tunnel wall support.
W71-05255

OPERATION AND MAINTENANCE MANUAL FOR MISSION HAMMERDRILL.
Mission Mfg. Co., Houston, Tex.

3rd Edition, 1968. 38 p.

Descriptors: *Drilling, *Water wells, *Drilling equipment, Wells.
Identifiers: *Hammerdrill, Percussion drilling, Drilling rate, Drilling operations, Bit weight, Rotation speed, Bit failure, Safety rules, Maintenance.

The Mission Hammerdrill is a pneumatically operated, bottom-hole drill that efficiently combines the percussive action of cable tool drilling with the rotary action of rotary drilling. The Hammerdrill can be used on any standard rotary rig with the necessary air-compressor capacity. It is used for fast and economical drilling of medium-hard formations in quarry, construction, water-well, oil-well, and geophysical work. Fast penetration results from several factors. Because the Hammerdrill is a bottom-hole tool, the piston blows are transmitted directly to the bit without losing percussive energy through the drill string. Thus the air is fully utilized for the rapid impacting action and for blasting and lifting cuttings from the hole. Continuous hole cleaning bares new formation to the bit so that practically no energy is wasted in chewing up cuttings. Straight hole is assured by short, rapid blows that minimize the effect of dipping and broken formation. A straight hole is easier to case and work over, easier to load with explosives or fit with a pump. (Campbell-NWWA)
W71-05289

NOVEL DRILLING TECHNIQUES,
Esso Production Research Co., Houston, Tex.
William C. Maurer.
New York, Pergamon Press, 1968. 114 p.

Descriptors: *Drilling, *Oil industry, Drilling equipment, Rock mechanics, Exploration, Research equipment.
Identifiers: *Rock destruction mechanisms, *Novel drilling techniques, Mechanical drilling, Thermal drilling, Vaporization drilling, Chemical drilling, Drilling performance data, Erosion jet drilling, Turbodrilling, Electric drilling.

Considerable research is going on throughout the world to develop new methods for drilling and excavating rock. In this study novel drills are defined as those which do not use conventional bits to attack rock. Considerable research is being done to develop bottomhole drilling motors such as electric drills and turbodrells. Although the devices described in this study are called novel, many of the concepts involved are quite old, as evidenced by the fact that the first flame drill was patented in 1853 and the first electric arc drill was patented in 1874. What we choose to call novel devices remove rock by four basic mechanisms: mechanically induced stresses, thermally induced stresses, fusion and vaporization, and chemical reactions. These devices have potential applications wherever rock is drilled, crushed, or excavated. Novel rock destruction methods will find initial application where rate of rock removal is more important than unit cost, such as in some military applications. They will also find application where restrictions are imposed on the rock destruction device (such as weight limitation in space exploration or size limitation in deep oil wells). Once novel methods find initial application, they will be refined and improved until their costs are reduced to the point where they find more widespread application in industry. Improvements are continually being made on equipment and techniques, so these new devices must be continually re-evaluated. Because of these continued improvements, some of the new drilling and excavating methods not economical today may find application in a few years. New devices that are exotic today may be conventional tomorrow. (Campbell-NWWA)
W71-05291

WATER WELL DRILLING WITH CABLE TOOLS,
Raymond W. Gordon.
Milwaukee, Wisconsin, Bucyrus-Erie Company, 1958. 230 p.

Descriptors: *Drilling, *Drill holes, Drilling equipment, Wells, Water supply, Groundwater, Sampling, Well screens.
Identifiers: *Cable tool drilling, *Drilling tool string, Fishing tool string, Pipe and casing, Drilling problems, Installation of screens, Well development, Mud scow drilling, Bit dressing, Well failures, Percussion drilling.

The book admits that there are about as many detailed procedures for drilling a water well with cable tool equipment as there are drillers, for each successful driller has developed his own drilling techniques over the years. Since each well differs from every other, an operator must watch developments constantly, planning in advance for anything which might delay operations. For these reasons, the material in this book is not set down as a rule but rather as one generally accepted method of handling percussion drills and cable tools. Countless operators have developed drilling and fishing tools to meet their needs. As a result of much ingenuity and experimentation, many effective tools are on the market today. Only tools which are in widespread use are discussed. (Campbell-NWWA)
W71-05292

WELL DRILLING OPERATIONS.

Dept Army Technical Manual TM 5-297 and Dept Air Force Manual AFM 85-23, Washington, DC, US Government Printing Office, September 1965. 249 p.

Descriptors: *Drilling, *Water wells, *Wells, Rotary drilling, Well screens, Pumps, Drawdown, Yield, Logging (Recording), Core drilling, Drilling equipment, Drilling fluids, Potable water, Groundwater.
Identifiers: Driven wells, Dug wells, Jetted wells, Drilled wells, Well construction methods, Percussion drilling, Methods, Well completion, Well development, Suction lift pumps, Deep well pumps, Arctic well development.

The purpose of this manual is to provide instruction and guidance for military personnel engaged in, or responsible for, establishing water sources by the use of wells; providing geological data through the medium of exploratory drilling, core drilling, and sampling; and providing demolition drilling support. It also serves as a basic text for the training of personnel in these areas. This manual covers the military applications of construction techniques for wells of all descriptions to include dug, bored, driven, jetted, and drilled wells. These are the types most likely to be constructed by military personnel in a theater of operations. It describes the use of equipment for developing groundwater sources and for associated uses including exploratory drilling, core drilling and sampling, and demolition drilling support. It discusses the various methods of well construction, related procedures for subsurface soil exploration, and drilling and tunneling for demolition emplacement. Operation of drilling equipment and the latest techniques in drilling for water are described in detail. Use of expedient methods for constructing wells is also described, since they may be required when standard well drilling equipment is not available. Discussed herein also are equipment and aids normally used in civil practice that may be adapted to military use. Multiple wells are discussed and the different types of pipe connections are explained. A chapter describes arctic well construction. (Campbell-NWWA)
W71-05293

AN EXPERIMENTAL STUDY OF INDEXED DULL BIT-TOOTH PENETRATION INTO DRY ROCK UNDER CONFINING PRESSURE,
Rice Univ., Houston, Tex.
P. F. Gmirk, and J. A. Musselman.

Society of Petroleum Engineers of AIME, Preprint No SPE-1712, 1967.17 p.

Descriptors: *Drilling, *Oil industry, Drilling equipment, Rotary drilling, Rock mechanics.
Identifiers: *Dull bit-tooth penetration study, Dry rock, Rock confining pressure, Indexing distance, Bit-tooth force, Optimum indexing distance.

Consideration is given to indexed penetrations by a single dull bit-tooth under statically-applied loads into rock subjected to confining pressures of atmospheric to 5,000 psi and atmospheric pore pressure. Experimental results obtained with a 45 deg wedge tooth over the above range of pressures are presented for two limestones and a sandstone, a variety of indexing distances, and two degrees of tooth dullness. The optimum distance between successive bit-tooth penetrations required for maximum rock damage and chip formation decreases substantially with increasing confining pressure above the brittle-to-ductile transition pressure of a particular rock, but remains approximately constant for a variation in confining pressure below the transition pressure. At a given condining pressure the bit-tooth force required for chip formation is constant for indexing distances greater than optimum but decreases linearly, in general, with decreasing indexing distance for distances less than optimum. The chip-formation force data obtained at confining pressures for which the chip-generation mechanism is macroscopically of a pseudosplastic nature compares favorably with previous theoretical results for indexed dull bit-tooth penetration into an idealized rigid/perfectly-plastic rock. (Campbell-NWWA)
W71-05303

THE PERFECT-CLEANING THEORY OF ROTARY DRILLING,
Jersey Production Research Co., Tulsa, Okla.
W. C. Maurer.
Journal of Petroleum Technology, p 1270-1274, November 1962. 12 fig, 21 ref.

Descriptors: *Rotary drilling, *Oil industry, *Drilling, Drilling equipment.
Identifiers: *Perfect-cleaning theory, Crater formation, Drilling-rate formula, Experimental data, Rate-power relationships, Imperfect-cleaning relationships.

A drilling-rate formula for roller-cone bits is derived from rock cratering mechanisms. This formula holds for 'perfect cleaning', which is defined as the condition where all of the rock debris is removed between tooth impacts. Under these conditions, the drilling rate is directly proportional to the rotary speed and to the bit weight squared, and inversely proportional to the bit diameter squared and to the rock strength squared. Under imperfect cleaning conditions, such as those usually present in field drilling, regrinding of the cuttings occurs under the bit, and the drilling rates fall below those for perfect cleaning. (Campbell-NWWA)
W71-05304

EFFORTS TO DEVELOP IMPROVED OIL-WELL DRILLING METHODS,
Jersey Production Research Co., Tulsa, Okla.
L. W. Ledgerwood, Jr.
AIME Petroleum Transactions, Vol 219, p 61-74, 1960. 25 fig, 23 tab, 73 refs.

Descriptors: *Drilling, *Oil industry, Drilling equipment, Rotary drilling.
Identifiers: *Novel drilling, Flame drill, Bottom hole hydraulic rotary, Electric arc, Chemical drilling, Pellet impact drill, Shock-wave drill, Calyx drill, Turbodrill, Rocket exhaust drill, Abrasive-jet drill, Continuous core drilling.

During the past three decades, the oil industry has expended increasing efforts seeking improved drilling tools or systems to reduce drilling costs. The total cost of these efforts is unknown, but it certainly amounts to tens of millions of dollars. Most of the 'new' systems that past and present investigators have sought to develop actually are old public information. In seeking to implement new-system concepts, investigators have tested the following: impact at frequencies ranging from 6 to 300 cycles per second; electrical, mechanical and hydraulic means of actuating percussors; bit rotary speeds up to 2,000 rpm; electric and hydraulic bottom-hole means of rotating bits; bottom-hole machines with power outputs up to 400 hp; shock waves; explosives; high-belocity pellets; flame; arc; grinding wheels; abrasive jets; erosion by high-velocity gases; chemical attack; electric current; magnetic waves; retractable rock bits; reelable drill pipe; continuous coring with reverse circulation; and automation of drilling rigs. In spite of these efforts to discover new and improved systems, rotary drilling maintains its economic leadership. Undoubtedly, rotary drilling costs will continue to be reduced by rigid application of the best available technology and by development of new rotary technology.In view of the extensive past development programs, however, significant long-range improvement appears to be a research, not a development problem. Research must postulate and prove theories and principles governing various subsurface rock-failure processes pertinent to both rotary and new systems. (Campbell-NWWA)
W71-05305

APPLICATION OF ROTARY DRILLING TO WATER WELLS,
J. P. Miller Artesian Well Co., Brookfield, Ill.
W. A. McEllhiney.
Journal American Water Works Association, p 351-355, March 1960.

Descriptors: *Drilling, *Water wells, *Rotary drilling, Drilling eqiupment, Oil industry, Wisconsin.
Identifiers: *Reverse rotary drilling, Well completions, Gravel wells.

In the water supply and industrial fields, rotary drilling equipment has successfully filled a need. It has reduced costs of test hole work and large-bore, gravel-packed wells. Well work involving conventional rotary drilling of large-bore wells (10-20inches) in deep sandstone has rarely been attempted in Wisconsin (1959). The author feels that rotary equipment deserves a fair trial in deep-sandstone type drilling in place of cable-tool drilling. (Campbell-NWWA)
W71-05307

IN HARD ROCK COUNTRY, PERCUSSION TOOL INCREASES DRILLING RATE, CUT COSTS,
Southern Natural Gas Co., Houston, Tex.
Joe B. Cobb.
World Oil, p 116-120, October 1962. 9 fig, 3 tab.

Descriptors: *Drilling, *Oil industry, Rotary drilling, Drilling equipment.
Identifiers: *Percussion rotary drilling, Operation, Economics, Air rotary drilling, Bits, Maintenance.

Southern Natural Gas Company has successfully used the percussion air drilling method to increase penetration rates four to ten times, and reduce over-all drilling costs as much as $16,000 on wells drilled in the hard rock country of San Juan and Grand Counties, Utah. Other advantages of the percussion air drilling technique follow: (1) Wells may be spudded easily in extremely hard formations, (2) straight hole conditions are maintained more easily because of reduced bit load requirements, (3) fewer drill collars are required, (4) less bit wear in some formations extends bit life, reduces required trips to change bits, and (5) larger cuttings are obtained for geologic analysis. Pneumatic percussion drilling now is becoming fully established as an aid to rotary drilling where air or gas can be used as the circulating medium. Although pressures required for operation of the percussion tool are higher (250-400 psi) than those applied in conventional rotary air drilling, booster compressors usually are available at a well for unloading operations and can be used to supply the higher pressure air needed for percussion tool operation. The extra energy is used to achieve increased chipping action at the bit and a higher penetration rate, and is especially effective in hard or brittle formations. (Campbell-NWWA)
W71-05308

BOTTOM-HOLE PERCUSSION TOOLS-WHERE AND HOW TO USE THEM,
Mission Manufacturing Co., Houston, Tex.
S.C. Berube, and R. N.Young.
Rock Products, p 79-81, October 1966.

Descriptors: *Drilling, *Oil industry, Wells, Drilling equipment.
Identifiers: *Bottom-hole percussion tool, Air volume requirement, Drill pipe size, Torque, Rotation speed, Water injection, Maintenance, Penetration rate.

Bottom hole percussion tools and bits are generally used under conditions where other drilling methods are uneconomical due to slow penetration rates, high bit costs or high rig maintenance costs. Requirements to insure the successful application of the bottom hole percussion drilling method are: (1) Adequate volume of compressed air to efficiently clean the hole, (2) Proper size drill pipe, (3) Sufficient pull down on the drill stem to keep the bit engaged against the rock face to be drilled, (4) Sufficient torque to turn the drill stem when the tool is drilling, (5) An adjustable speed rotary mechanism, (6) A means of tool lubrication, (7) Adequate hoisting capacity to lift the tool and drill pipe from the deepest hole the driller expects to drill, (8) Proper breakout equipment to service the tool, (9) A means of sharpening bits. (Campbell-NWWA)
W71-05309

DRILLING FOR THE MAN ON THE RIG,
Oil and Gas Journal, Tulsa, Okla.
Preston Moore.
Technical Manual Reprint, Oil and Gas Journal, 1966. 72 p.

Descriptors: *Drilling, *Oil industry, *Rotary drilling, Equipment, Drilling fluids, Muds, Cement grouting.
Identifiers: *Drilling control factors, *Drilling fluid selection, Drilling fluid composition, Drilling fluid control, Drilling fluid circulation, Hole conditions, Rotary drilling hydraulics, Hole problems, Primary cementing mechanics, Air and gas drilling, Minimum-cost drilling.

The men on the rig spell the difference between economic success and failure in drilling operations. The best technology is useless if it is not applied on the rig daily. This manual is an effort to improve drilling operations. This series of articles incorporates the latest in technology for use by the man in the field. The first step in planning a new well should be a review of all the available information on past wells in the area. This information should be evaluated to determine practices that should and should not be used in the proposed well. This means that second guessing is an accepted as well as a necessary practice. Information, from the bit to use to the best cementing procedures, can save considerable drilling time and trouble. (Campbell-NWWA)
W71-05314

NEWS TOOLS AND PROCEDURES FOR BETTER DRILLING OPERATIONS,
Oil and Gas Journal, Tulsa, Okla.
H. G. Bentson.
Technical Manual Reprint, Oil and Gas Journal, 1964. 56 p.

Descriptors: *Drilling, *Oil industry, *Rotary drilling, Equipment, Drilling fluids, Mud.
Identifiers: *Rock-bit design, *Rock-bit selection, Rock-bit evaluation, Cyclone samplers, Drilling

rates, Turbodrill, Turbodrill bit, Formation compressive strength, Surfactants, Rotary speed, Bit weight, Air drilling, Mud drilling.

This booklet describes in considerable detail the various aspects of rock-bit design, selection and evaluation. In addition, rotary drilling rate is examined. Variables affecting rotary-drilling penetration rate are exceedingly numerous. Some of the more recognizable are the effects of drilling-fluid properties, hydrostatic pressure, hydraulic factors, rotary speed, and weight on bit. Also involved are personnel-rig efficiency, straight-hole requirements, and the extreme variance of rock properties and other subsurface conditions in different areas. The various features of the turbodrill is discusses with emphasis on the present lack of adequate bit design features and supporting mud pump capacities. (Campbell-NWWA)
W71-05316

HOW TO COMBAT LOST CIRCULATION,
Oil and Gas Journal, Tulsa, Okla.
J. U. Messenger, J. W. Murray, J. Kelly, Jr., J. R. Eckel, and R. A. Bobo.
Technical Manual Reprint, Oil and Gas Journal, 1969. 50 p.

Descriptors: *Drilling, *Oil industry, Equipment, Drilling fluids, Mud, Rotary drilling.
Identifiers: *Lost circulation, Mud hydraulics, Drilling rate, Problem shales, Parasite tubing string.

Lost circulation is the most troublesome and costly problem in drilling. While no functionally new lost - circulation materials or techniques have been developed in the past 10 years, progress has been made by using existing techniques and materials more effectively. The purpose of this series of articles is to outline these more effective procedures of lost-circulation prevention and control. The different types of loss zones are classified on the basis of severity. Then the different materials and techniques are matched to type and severity of the zone they most likely can cure. Attention is given to methods of preventing lost circulation, and a list is given of the most usual causes of failure to control lost circulation. (Campbell-NWWA)
W71-05317

NEW EQUIPMENT AND OPTIMUM DRILLING TECHNIQUES MAKE FOR BETTER DRILLING PRACTICES,
Oil and Gas Journal, Tulsa, Okla.
E. M. Galle, H. B. Woods, W. R. Greene, L. C. Rogers, and H. M. Rollins.
Technical Manual Reprint, Oil and Gas Journal, 1967. 69 p.

Descriptors: *Drilling, *Oil industry, *Rotary drilling, Equipment, Drilling fluid, Mud.
Identifiers: Constant bit weight, Constant rotary speed, Packer terminology, Tool joints, Drill pipe, Drill collars, Electric drive rig, Rig design.

For each particular drilling situation and rig, there is some 'best' combination of bit weight and rotary speed. If this weight and speed are held constant throughout the bit run, they produce the lowest possible cost. No other combination of speed and weight held constant will be so efficient. This booklet lays out in cook-book fashion a method of the figuring the best constant bit weight and rotary speed. Other topics covered include: Packer terminology and recommended standardization, ways of assuring money's worth from tool joints and drill pipe, ways of avoiding drill collar damage, and new ideas on electric drive rigs. (Campbell-NWWA)
W71-05318

HOW TO SELECT THE CORRECT SAND CONTROL SYSTEM FOR YOUR WELL,
Dow Chemical Co., Los Angeles, Calif. Dowell Div.
A. W. Coulter, and D. G. Gurley.
Society of Petroleum Engineers of AIME, Preprint No SPE-3177, 1971. 6 p, 10 ref.

Descriptors: *Screens, *Permeability, Oil industry, *Water wells, Drilling.
Identifiers: *Sand control system, *Water well completion, Gravel packs, Resin sand consolidation, Resin-coated gravel packs.

There has long been a need for a guide to the selection of the sand control system needed for a particular well. There are four types of systems in use today: (1) screens, (2) gravel packing, (3) sand consolidation and (4) a resin-coated particulate such as sand. Although universal agreement may not be possible at this time, there are certain guidelines that are followed. The factors involved include formation permeability, clay and silt content of formation, interval length, number of zones, homogeneity, well history, type completion, depth, expense of right time and others. This paper will consider these factors and their influence on the selection of sand control systems. (Campbell-NWWA)
W71-05320

HOLE CLEANING,
Shell Development Co., Houston, Tex.
E. A. Hopkin.
Society of Petroleum Engineers of A.I.M.E., Preprint No SPE-1697, 1967. 12 p.

Descriptors: *Drilling fluids, *Drilling, Rotary drilling, Drilling equipment, Muds, Oil industry.
Identifiers: *Drilling rate, *Theory of particle settling, Viscosity effect, Mud density effect, Drill-pipe rotation effect, Cuttings removal rate, Hole enlargement, Stuck drill pipe.

Laboratory tests conducted by Shell Canada, Ltd. together with actual field experience have indicated the magnitude of some of the factors affecting the ability of the drilling mud to clean the hole. A correlation was observed between funnel viscosity and particle slip velocity. A relationship was also observed between the Bingham yield value of the mud and the particle slip velocity. No change is slip velocity was observed with funnel viscosities up to about 80 sec/qt. or to yield values of about 15 lb/100 sq ft. The slip velocity of the particles studied varied from 120 ft/min. with water to close to 0 ft/min. for high mud viscosities. Increasing the mud density, creating laminar annular mud flow or rotating the drill pipe appeared to improve the carrying capacity. Field tests indicated that during fast upper-hole drilling, the rate of cutting removal must be sufficient to maintain the concentration of cuttings in the annulus at less than 5 per cent by volume to prevent balled-up drill collars and stuck drill pipe. (Campbell-NWWA)
W71-05321

THE STRAIGHT HOLE TURBODRILL,
Eastman Oil Well Survey Co., Tulsa, Okla.
David B. Shulz.
Society of Petroleum Engineers of A.I.M.E., Preprint No SPE-3230, 1971. 8 p, 8 fig, 4 tab.

Descriptors: *Drilling, *Drilling equipment, Rotary drilling, Oil industry, Core drilling.
Identifiers: *Turbodrilling, Directional turbodrilling, Straight-hole turbodrilling, Turbodrill application, Turbodrill diamond bits, Horsepower requirements.

From the first patent of a turbodrill in 1884, a span of 70 years of development and improvement was necessary before the beginning of its use as a directional drilling tool. Improvements in directional turbodrills led to the marketing of the straight-hole turbodrill and its use in problem areas of vertical wells and directional wells. Diamond bits used with turbodrills must be built with large water courses and low pressure drop across the face. Cleaning and cooling is accomplished by changes in the flow characteristics of the fluid as the rotating speed of the bit is increased. Horsepower output of a turbodrill is affected by changes in the number of turbine stages in flow rate and in volume of fluid. A summary of drilling records show some applications of the turbodrill. Greater drilling depths of the future will present more problems and more applications of all down-hole motors. (Campbell-NWWA)
W71-05323

8B. Hydraulics

ANALYSIS OF THE USE OF DISTORTED HYDRAULIC MODELS FOR DISPERSION STUDIES,
California Univ., Berkeley. Dept. of Civil Engineering; and Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W71-04853

FLOOD ROUTING THROUGH STORM DRAINS: PART I. SOLUTION OF PROBLEMS OF UNSTEADY FREE SURFACE FLOW IN STORM DRAINS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W71-04890

FLOOD ROUTING THROUGH STORM DRAINS: PART II. PHYSICAL FACILITIES AND EXPERIMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W71-04891

FLOOD ROUTING THROUGH STORM DRAINS: PART III. EVALUATION OF GEOMETRIC AND HYDRAULIC PARAMETERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W71-04892

WATER HAMMER AND SURGE TANKS,
G. V. Aronovich, N. A. Kartvelishvili, and Ya. K. Lyubimtsev.
Available from NTIS as TT70-50025, $3.00 in paper copy, $0.95 in microfiche. Trans. of Gidravlicheskii Udar i Uravnitelnye Rezeruary, Moscow, 1968. Israel Program for Scientific Translations, 1970. 209 p. Jerusalem, 1970. 203 p.
Identifiers: *Water hammer, *Hydraulic equipment, *Surge tanks, Performance, Unsteady flow, Pipes (Tubes), Theory, Oscillations, Stability, Translations, USSR.

The book considers unsteady motion of liquids in hydraulic pressure systems (hydroelectric power stations, water and petroleum conduits, pressure irrigation systems, hydraulic fuel supply systems, etc.). The general theory of water hammer is presented for simple conduits and complex piping systems. Probability problems of water hammer related to the probability nature of laws governing valve closure are considered, as well as the relationship between these problems and conduit reliability. Surge-tank operation is considered from the following points of view: (1) as a means of damping out water hammer; (2) as a device having a substantial effect on the stability of steady hydraulic regimes; (3) as device whose overall dimensions must be established by hydraulic calculations. The relationship between water hammer and fluctuations of the liquid masses in the surge tanks is analyzed.
W71-04940

EXPERIMENTAL FLUME INVESTIGATION OF HYDRAULIC TRANSIENTS IN RIVER-RESERVOIR SYSTEMS,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 02E.
W71-05087

APPROXIMATE SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR FLOW THROUGH A RECTANGULARLY PACKED BED OF SPHERES,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02F.
W71-05111

PRACTICAL RESERVOIR ENGINEERING,
Tulsa Univ., Okla.
E. T. Guerrero.
Tulsa, Oklahoma, Petroleum Publishing Company, 1968. 266 p.

Descriptors: *Oil industry, *Hydraulics, *Aquifers, *Groundwater, Design, Porosity, Permeability, Rock properties, Logging (Recording), Electric log, Unsteady flow.
Identifiers: Effective porosity determination, Washburn-Bunting porosimeter, Microlog, Microlaterlog, Neutron-Derived porosity curve, Absolute permeability, Effective permeability, Productivity index, Steady-state relative-permeability measurements, Interstitial-water saturation determinations, Smith equation, Curtis and Brinkley method.

The practical methods of the petroleum industry for reservoir engineering are presented in 102 parts. Practical applications are emphasized and enough theoretical concepts and references are included to give interested readers the fundamentals of the methods used by the petroleum industry. This book demonstrates most of the practices and concepts used by the industry which overlap similar practices used in the groundwater industry. Significant semantic differences exist but considerable advances have been made which should have spin-off value for use in groundwater engineering, especially as deeper groundwater is sought in the future and increased pressures, temperatures, etc., are encountered. The text is well-illustrated and well-referenced and should be of interest to workers involved in groundwater reservoir studies. (Campbell-NWWA)
W71-05290

BAROID DRILLING MUD DATA BOOK.
National Lead Co., Houston, Tex. Baroid Div.

Houston, Texas, National Lead Company, Baroid Division, 1954. 471 p.

Descriptors: *Drilling fluids, *Drilling, *Oil industry, Emulsions, Foaming, Mud, Wells, Expansive clays, Bentonite.
Identifiers: Drilling mud properties, Chemical treatment, Oil muds, Basic mud mixing, Drilling mud costs, Mud field tests, Drilling mud problems, Lost circulation, Drilling mud engineering, Aquagel, Impermex, Baroco, Zeogel, Anhydrox, Emulsion mud.

This reference is a complete text on drilling fluid theory and application despite its commercial intent. The following topics are discussed in detail; History, function and types of drilling mud, clays, weighing material, chemical treatments, oil mud use, basic mud mixing techniques, cost appraisals, field testing, trouble shooting, lost circulation problems and their solution. The text is well illustrated and referenced and has been updated since its publication in 1954. An extensive glossary is also included. The text constitutes 14 sections, each being self-contained. (Campbell-NWWA)
W71-05294

PETROLEUM ENGINEERING, DRILLING AND WELL COMPLETIONS,
Texas Univ., Austin.
Carl Gatlin.
Englewood Cliffs, New Jersey, Prentice-Hall Inc., 1960. 341 p.

Descriptors: *Drilling, *Oil industry, *Rotary drilling, Drilling equipment, Sampling, Drilling fluids, Logging (Recording), Cementing, Casing.
Identifiers: *Well completion, Drill stem testing, Formation damage, Core analysis, Penetration rate, Rotary drilling hydraulics, Cable tool drilling, Rock properties.

The book presents an integrated picture of oil well drilling and well completion operations as they are normally encountered by the petroleum engineer. In order to do this without assuming prior knowledge in the field, a number of rather general topics have been included. The chapters on reservoir fluid properties, reservoir rock properties, exploration and leasing practices, core analysis, well logging and formation damage fall into this category. The emphasis is on the specific problem rather than an over-all implications. Petroleum engineering curricula vary widely as to the level at which the drilling course is taught. By including the necessary background material, this text could be considered a first course. It is well illustrated and contains adequate references. (Campbell-NWWA)
W71-05296

WHAT'S NEW WITH MUD.
National Lead Co., Houston, Tex. Baroid Div.

Special Report, 1966. 35 p.

Descriptors: *Drilling fluids, *Drilling, *Oil industry, Emulsions, Foaming, Mud, Wells, Expensive clays, Bentonite, Corrosion.
Identifiers: *Drilling mud properties, Drilling rate, Hole stability, Solids control, Temperature stability, Rheology, Limestone and sandstone penetration rates, Wet shales, Swelling shales, Shale shakers.

Like most other phases of the petroleum industry, the technology, techniques and products used in drilling fluids changed significantly during the middle 1960's. This booklet is an attempt to update previous work on drilling mud developments and techniques. Improvements in drilling rates using new mud techniques have been realized. Hole stability techniques have also been improved as have techniques of solids control, downhole mud temperature stability and corrosion. This booklet is very well illustrated. New experimental studies are discussed. (Campbell-NWWA)
W71-05301

EFFECT OF MUD COLUMN PRESSURE ON DRILLING RATES,
Imperial Oil Ltd., Calgary (Alberta).
A. S. Murray, and R. A. Cunningham.
AIME, Petroleum Transactions, p 46-54, 1956. 11 fig, 10 ref.

Descriptors: *Drilling fluids, *Mud, *Drilling, *Oil industry, Rotary drilling.
Identifiers: *Drilling rate, *Drillability, Confining pressure, Bit load, Drag bit.

If a dense fluid such as mud or water is used for circulation, the formation drilled is influenced by a hydrostatic pressure. This pressure depends on hole depth and drilling fluid density. Laboratory tests indicate that drilling rates in many formations are decreased with increased pressure - in some cases as much as 90 per cent. A comparison between laboratory and field tests indicate that drilling fluid head affects drilling rates in the field approximately the same as in the laboratory. Drilling rates of many formations are increased by reducing drilling fluid head. (Campbell-NWWA)
W71-05311

8C. Hydraulic Machinery

INSTITUTIONAL DESIGN FOR WATER QUALITY MANAGEMENT: A CASE STUDY OF THE WISCONSIN RIVER, VOL. 5, SECTION G - SYSTEMS ANALYSIS OF HYDROPOWER PRODUCTION ON THE WISCONSIN RIVER,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W71-05039

THERMOELECTRIC GENERATORS POWERED BY THERMAL WASTE FROM ELECTRIC POWER PLANTS,
Federal Water Quality Administration, Corvallis, Oreg. Pacific Northwest, Water Lab.
M. A. Shirazi.
Federal Water Quality Administration, Water Pollution Control Research series 16130, September, 1970 presented at the IECEC Energy 70 Conference, Las Vegas, Nevada, Sept, 1970, p 27. 5 fig, 5 tab, 6 ref.

Descriptors: *Thermal pollution, *Electric powerplants, Heat exchangers, Condensers, Costs, Heat transfer, Temperature, Cooling water, Water pollution control, *Thermal powerplants.
Identifiers: *Thermoelectric generators, Thermal waste, Turbine back pressure, Power density, Power intensity.

A crossflow type heat exchanger with the plate fin surface geometry is described. The plate separating the hot fluid from the cold fluid contains the thermoelectric unit. Equations for calculating convective heat transfer coefficients, the friction power extended per unit surface area and the maximum conversion efficiency are described. The alloys considered in this study were Bi2Te3 - Bi2Se3 (n type) and Bi2Te3 - Sb2Te3 (p type). While conducting the latent heat from the condensing steam to the cooling water, the couples convert a portion of this heat to electricity. A second source of waste heat in a conventional fossil-fueled electric powerplant is the hot stack gases released into the atmosphere. Another source is hot exhaust gases from a gas turbine electric power system. Condenser performance data are presented in three separate tables. Power generated increases with turbine back pressure. A capital cost estimate for three plate module thickness of 0.01, 0.02 and 0.05 inch are estimated at $1250, $1560 and $3720 per kw, respectively. Ratio of the cost of thermoelectric to stream electric generation increased with plate thickness and is as high as 14 for a plate thickness of 0.05 inch. It is uneconomical, at the present time, to use thermoelectric devices to generate electricity from waste heat. (Upadhyaya-Vanderbilt)
W71-05121

WATER TRANSPORT OF THE ODD-SHAPED HEAVY RUNNERS OF LARGE FRANCIS HYDRAULIC TURBINES,
Bureau of Reclamation, Denver, Colo.
M. I. Galperin, and A. V. Chekulaev.
Available from NTIS as PB-193 593, $3.00 in paper copy, $0.95 in microfiche. Translated from Energomashinostroenie No 2, p 45, 1966. Bureau of Reclamation Translation No 674, Sept 1966. 7 p, 2 fig, 1 ref.

Descriptors: Turbine parts, *Turbine runners, Hydraulic turbines, *Francis turbines, Foreign projects, Handling equipment, *Transportation, Hoisting machinery, *Waterways, Sandbars, Rivers, Boats, Weather, Loads, Ports, Locks, Barges.
Identifiers: Krasnoiarsk Powerplant (USSR), North Sea-Baltic Wtrwy (USSR), Enisei River (USSR), Leningrad Metalworks (USSR).

During the summer of 1965 the first two runners for the Krasnoiarsk 508-mw turbines were successfully transported from the Leningrad Metalworks (LMZ) pier to the construction site of the hydrocomplex on the Enisei River in Siberia. The runners were loaded one at a time at the LMZ pier from railroad transport flatcars to a lighter. At the Leningrad Commercial Seaport they were unloaded by the harbor facilities and then reloaded together with two generator thrust bearing tanks into the hold of a single sea-going barge. The route was through the White Sea-Baltic Seaway, containing numerous, relatively small, one- or two-chambered locks, where the help of tugs and warping hawsers was needed to lock the barge. Through the Northern Seaway along the coast of the Arctic

Ocean, fogs, icepacks, and stormy weather were encountered, but the method of loading and lashing the runners proved to be satisfactory. The Enisei River has many rapids and sandbars from its mouth to the unloading point at Divnogorsk. These required the help of special local tugs and a river pilot. Docking and unloading the runners each required less than 24 hours to accomplish. Success in handling these loads confirms the possibility of handling and transporting the runners for the Aswan High Dam turbines to the UAR in the same way.
W71-05251

SYSTEMS OF HYDRAULIC AUTOMATIC CONTROL IN IRRIGATION CANALS,
Bureau of Reclamation, Denver, Colo.
I. B. Khamadov, F. Ya. Eingorn, and L. A. Om.
Available from NTIS as PB-193 649T, $3.00 in paper copy, $0.95 in microfiche. Translated from: Gidrotekhnika i Melioratsiya No 3, p 36-48, 1967. Bureau of Reclamation Translation No 723, Jan 1968. 35 p, 6 fig, 12 ref.
Identifiers: *Irrigation systems, Automation, *Hydraulic systems, Design, Control systems, Costs, Operation, USSR, Translations, Water use, Irrigation canals.

Several institutions in the Central Asian republics of the USSR have cooperated to develop an automated system of hydraulic controls for irriagation canals. After studying foreign and domestic systems of upstream and downstream controls of all types, they devised a mixed-control system, actuated by direct and reflected hydraulic surges in the canal. This system combines the advantages and features of both upstream and downstream hydraulic controls without a number of their separate disadvantages, but requires canal bottom slopes of less than 0.0003 and costs 9 to 22% more to build than a system with just upstream control. However, the mixed control system is easier, more flexible, and more reliable in operation.
W71-05252

BEST CONSTANT WEIGHT AND POTARY SPEED FOR ROTARY ROCK BITS,
Hughes Tool Co., Houston, Tex.
E. M. Galle, and H. B. Woods.
Reprint: Presented at the Spring Meeting of the Pacific Coast District Division of Production, American Petroleum Institute, Los Angeles, May 1963. 37 p.

Descriptors: *Drilling, *Oil industry, Drilling equipment, *Rotary drilling, Rock excavation, Rock mechanics, Drill holes, Drilling fluid.
Identifiers: *Mathematical analysis, Drilling rates, Optimum rotary speed, Optimum constant weight, Drilling cost, Teeth condition, Bearing life, Formation characteristics.

This is a study of the best constant weight and rotary speed for lowest drilling cost for rolling cutter rock bits. Graphs and charts for a variety of formations are presented for field application. The results of several field test are as follows: (1) mathematical relations have been developed for determining the best constant weight and rotary speed for lowest drilling cost, (2) graphs and procedures have been developed to determine: (a) the best combination of constant weight and rotary speed, (b) the best constant weight for any given rotary speed, (c) the best constant rotary speed for any given weight, (3) in each graphical procedure of the above, drilling cost, footage, drilling time and condition of teeth and bearings of the dull bit may be calculated. (4) Field tests have demonstrated that drilling costs may be reduced by using the weight and rotary speed combinations recommended in this study. (Campbell-NWWA)
W71-05297

ROTARY DRILLING BITS.
Hughes Tool Co., Houston, Tex.

Houston, Texas, Hughes Tool Company, 1966. 37 p.

Descriptors: *Drilling, *Oil industry, *Water wells, Wells, Drilling eqiupment, Drilling fluids, Rotary drilling.
Identifiers: *Rotary drilling bit design, Rock drillability, Bit types and usage, Circulating media, Dull bits, Drilling records.

The introduction of the rolling conical cutter bit greatly increased the economic feasibility of drilling hard formations and led to the general acceptance of the rotary method of drilling oil and water wells. Most types of rock bits will make fair progress in the majority of formations. However, to obtain maximum footage with lower drilling costs, the type of bit should be designed for the specific type of formation being drilled. Various types of bits, several different broad classifications of formations and the types of rock bits best suited to drill them is examined. Examination of dull bits can often furnish information that will assist the selection of bit types and help to determine operating practices. Other topics such as (1) importance of bit records, (2) importance of using proper drilling muds with bits, and (3) selection and operation of rolling cutter bits are discussed. Excellent illustrations are included. (Campbell-NWWA)
W71-05298

KNOW YOUR MUD PUMP,
Mission Mfg. Co., Houston, Tex.
S. L. Collier, W. E. Liljestrand, C. V. Aalaund, N. B. Heaps, and C. P. Reid.
1965. 64 p.

Descriptors: *Drilling fluids, *Pumps, Centrifugal pumps, Hydraulic systems.
Identifiers: *Mud pump research, Normal pump behavior, Friction losses, Suction dampeners, Pressure requirements, Hydraulic knocking, Mechanical knocking, Discharge pressure system, Volumetric efficiency, Reciprocating mud pumps.

Drilling costs can be reduced through a better understanding of the mud pump and accessory equipment. The preliminary results of controlled laboratory tests made with modern instrumentation will aid in acquiring a better knowledge of pump operation. The mud pump is the main element of the surface mud system, but it is only a link in the three element chain consisting of the suction system, the mud pump itself and the discharge system. The actual requirements of the suction system must be understood in order to establish the correct operating conditions for the mud at the pump suction flange. To know what is required of the suction system, both the normal and abnormal situations that occur during, and as a result of, the suction stroke of the piston must be understood. In the discharge stroke, the piston's pattern of motion is molded into a completely different pattern by the complexity of the discharge system. Each element of the system should be operated for the maximum effectiveness by controlling the problems of each through the best use of the piping and the mud reserve, or when necessary, the proper use of the auxiliary equipment. (Campbell-NWWA)
W71-05300

BIT TIPS,
Hughes Tool Co., Houston, Tex.
M. A. Foreman, R. J. Schneider, J. H. Cook, W. J. Highbarger, and T. B. Smith.
Vol 2, 1970. 33 p.

Descriptors: *Drilling, *Oil industry, *Water wells, Wells, Drilling equipment, Drilling fluids, Rotary drilling, Logging (Recording).
Identifiers: *Bit design, *Bit stabilization, Jet nozzles, Bit selection, Bit bearings, Super bit, Well planning, Bit weight, Rotary speed, Formation characteristics, Well logs.

In designing rock bits, space is the controlling factor because the sizes of the parts are determined by the size of the hole to be drilled. Proper selection of the right proportions for the various parts, such as tooth size, cone shell thickness, and bearing sizes is required. It is known that rock bits perform best when rotating about their own axis. Bearing life, because of reduced thrust loading, is also extended when the bit rotates about its own center - especially under maximum loading. The advent of jet bits was major breakthrough in obtaining greater penetration rates. Properly directed jet streams combined with correct nozzle sizes clean the cones of the bit and provide efficient removal of cuttings from bottom. Other topics such as bit stabilization, well logs and bit selection, and optimum bit weight and rotary speed are also discussed. (Campbell-NWWA)
W71-05302

RUSSIAN TURBODRILLS.....HOW GOOD ARE THEY.
World Oil Publishing Co., Tulsa, Okla.

World Oil, p 151-158, December 1956.

Descriptors: *Drilling, *Drilling equipment, Rotary drilling, Oil industry.
Identifiers: *Russian turbodrills, Penetration rates, Developmental history, Turbodrill-conventional rotary comparison.

In recent months (1956), the drilling industry became aware of the possibilities inherent in having a down-hole source of power for driving the drill bit. Scattered and unsuccessful test have been carried on in the U.S. since 1873, but with the reported success of Russian turbodrilling there was widespread interest in this method. Tool manufacturers and drilling personnel anxiously awaited the results of the tests to be conducted on 40 imported Russian turbodrills. Dresser Industries were active in the development and testing of earlier American turbodrills. (Campbell-NWWA)
W71-05306

PORTLAND HARBOR EVALUATION,
Maine Port Authority, Portland.
For primary bibliographic entry see Field 05G.
W71-05327

8D. Soil Mechanics

FLOW THROUGH A TAILINGS POND EMBANKMENT,
Bureau of Mines, Spokane, Wash., and Idaho Univ., Moscow.
C. Dan, aKealy, and Roy E. Williams.
Water Resources Research, Vol 7, No 1, p 143-154, February 1971. 12 p, 9 fig, 2 tab, 15 ref.

Descriptors: *Earth dams, *Seepage, *Underseepage, *Mine wastes, *Laplaces equation, Dam failure, Earthworks, Ponding, Dam design, Flow, Porous media, Water levels, Drainage, Leakage, Hazards, Model studies, Hydraulic models, Mathematical models, Computer models.
Identifiers: *Tailings ponds.

Mathematical models that solve the Laplace or Richards' equation numerically are used to locate the phreatic surface within a mine tailings pond embankment and to define the subsurface flow system that transports water outward from the pond. Input data needed for the finite element model include the saturated hydraulic conductivity distribution within and beneath the embankment, the fluid potential values at both upgradient and downgradient boundaries of the embankment, and the geometry and elevation of an approximately impermeable layer at some depth beneath the surface of the embankment. This technique was applied to a tailing disposal system in northern Washington. Laboratory tests were used to obtain permeability values. Pond boundaries were examined by drillholes and piezometers. Piezometers were also used to validate the configuration of the

phreatic surface predicted by the model. Of particular importance to slope stability analysis is the fact that both the model and the check piezometers indicate that a significant portion of the phreatic surface within the embankment is concave upward. Experimentation with the finite element model revealed that the concave upward portion is a consequence of the upstream boundary in a tailings pond being a flow line and embankment permeability being lower near the upstream boundary; the upstream boundary of the flow region in an earth dam is normally an equipotential line. (Knapp-USGS)
W71-04862

STABILITY OF CLOSED HORIZONTAL DRAINAGE IN THE GOLODNAYA STEPPE,
Bureau of Reclamation, Denver, Colo.
E. M. Ostrovskii, and A. A. Dyadik.
Available from NTIS as PB-193 616T, $3.00 in paper copy, $0.95 in microfiche. Translated from: Gidrotekhnika i Melioratsiya Vol 18, No 6, p 22-36, 1966. Bureau of Reclamation Translation 684, Oct 1967. 21 p, 12 fig, 6 ref.
Identifiers: *Hydrology, USSR, *Soils, Drainage, Design, Stability, Sand, Clay, Deformation, Floods, Translations, Golodnaya Steppe.

The results of laboratory investigations of the filtering stability of Golodnaya Steppe soils with various types of filters, as well as the critical analysis of investigations under natural conditions indicated steps necessary in planning a drainage system.
W71-05254

LOW-TEMPERATURE PHASES OF INTERFACIAL WATER IN CLAY-WATERS SYSTEMS,
Cold Regions Research and Engineering Lab., Hanover, N.H.
For primary bibliographic entry see Field 02C.
W71-05258

USE OF GEOPHYSICAL LOGS IN SOIL ENGINEERING,
Mandrel Industries, Houston, Tex. Well Instrument Div.
Hubert Guyod.
American Society for Testing and Materials, Special Technical Publication No 351, p 74-85, 1963. 10 fig, 2 tab, 8 ref.

Descriptors: *Logging (Recording), *Water wells, *Soil engineering, Electrical well logging, Radioactive logging, Drilling, Coring, Groundwater.
Identifiers: *Accoustical logging, *Test wells, Logging methods, Electrical resistivity, Natural Gamma Ray logging, Gamma-Gamma logging, Neutron logging, Velocity logging, Matrix velocity.

The measurement of some of the physical properties of the soils and rocks penetrated by bore holes provides information of value to the soil engineer. Electrical resistivity, radiation, and acoustical properties are particularly useful. The measurements continuously recorded in terms of depths give a detailed log on which geological and physical changes are indicated. In a typical case, the field operations are conducted as follows: (1) A small number of test wells scattered over the area of interest are drilled, cored, and logged with one or several appropriate probes; (2) additional holes are then drilled between the test wells; and (3) these holes are logged but not cored. By correlating the logs and the core data the geology of the area and some of the rock properties can be mapped. None of the methods reviewed, however, can be used to measure dynamic properties. The main advantages of geophysical logs are that detailed information is readily obtained at the well sites and at a lower cost than if each hole were cored. The equipment used for the logging of shallow holes is small, light, rugged and simple. No special technician is needed for its operation. (Campbell-NWWA)
W71-05310

8E. Rock Mechanics and Geology

AN EXPERIMENTAL STUDY OF INDEXED DULL BIT-TOOTH PENETRATION INTO DRY ROCK UNDER CONFINING PRESSURE,
Rice Univ., Houston, Tex.
For primary bibliographic entry see Field 08A.
W71-05303

IN HARD ROCK COUNTRY, PERCUSSION TOOL INCREASES DRILLING RATE, CUT COSTS,
Southern Natural Gas Co., Houston, Tex.
For primary bibliographic entry see Field 08A.
W71-05308

ANNOTATED TABLES OF STRENGTH AND ELASTIC PROPERTIES OF ROCKS,
Illinois Univ., Urbana.
Rudolph G. Wuerker.
AIME, Petroleum Transactions Report No 6, p 23-45, 1969. 7 fig, 5 tab, 75 ref.

Descriptors: *Rock mechanics, *Drilling, *Mining, Physical properties, Oil industry, Sandstone, Limestone, Granite, Marble, Rocks, Strength, Mohr envelop.
Identifiers: *Drillability, *Grindability, *Blastability, U.S. Bureau of Mines, U.S. Bureau of Reclamation, Mhr's hardness scale, Load influence, Temperature factor, Time factor.

Testing for strength and elastic properties of rocks has made rapid progress since the end of World War II. The perfection of standard methods and the awakening interest of all branches of the mineral industry resulted in the collection of a great amount of new physical data on the most common rocks. Interpretation and correlation with technological properties, such as grindability, drillability, and blastability, however, have not kept pace. One of the reasons for this may be the fact that test results on strength and elastic properties are widely scattered in the technical literature. The purpose of this paper is to tabulate the results from such standardized tests and to discuss the importance of each property and its usefulness to the mineral engineer as reflected in the existing literature. Twenty-one rock properties are listed in tables, which have been encountered in mining and petroleum exploration. Not all twenty-one properties have been measured as yet from any one rock but an attempt is made to make the various results match as well as possible. The report is exceptionally well referenced. (Campbell-NWWA)
W71-05312

A NEW APPROACH TO INTERPRETING ROCK DRILLABILITY,
Petroleum Publishing Co., Tulsa, Okla.
M. Grant Bingham.
Technical Manual Reprint, Oil and Gas Journal, 1965. 93 p.

Descriptors: *Drilling, *Oil industry, *Rotary drilling, Equipment, Drilling fluids, Muds, Rock mechanics, Rock properties.
Identifiers: *Rock drillability, *Drilling performance interpretation, Bit design, Bit performance, Performance line, Rotary speed, Laboratory drilling.

Rotary drilling is an anachronism. It stands as the last remaining art in an industry where virtually all other operations have been reduced to a science. A single link remains to be forged before drilling also can elevate itself to scientific status. That vital link is a thorough understanding of what happens on the bottom of the hole as the bit rolls over it. This plan of action measures only a few square inches, but it is the location of the only 'useful' work performed in drilling. This manual relates rotary drilling to rock strength, or rock drillability. The aim of establishing such a relation is to allow prediction of the behavior of a drill bit from one well to the next. To accomplish this objective mathematical equations must be derived which describe the interaction of bit and rock. The author firmly believes that equations can be written to describe and predict drilling in the field. More than 26 variables have been identified which influence drilling. Without understanding their effects, maximum drilling efficiency and minimum costs can never be reached. (Campbell, NWWA)
W71-05313

NEWS TOOLS AND PROCEDURES FOR BETTER DRILLING OPERATIONS,
Oil and Gas Journal, Tulsa, Okla.
For primary bibliographic entry see Field 08A.
W71-05316

EXPLOSIVES RESEARCH TO IMPROVE FLOW THROUGH LOW PERMEABILITY ROCK,
Bureau of Mines, Bartlesville, Okla.
For primary bibliographic entry see Field 08H.
W71-05322

8F. Concrete

MILD HYDRATION HEAT CEMENT FOR THE INGURSK ARCH DAM,
Bureau of Reclamation, Denver, Colo.
P. P. Tsulukidze, N. L. Monina, and Z. S. Avalyani.
Available from NTIS as PB-193 614T, $3.00 in paper copy, $0.95 in microfiche. Translated from: Gidrotekhnicheskoe Stroitel'stvo No 2, p 27-29, 1965. Bureau of Reclamation Translation No 681, Dec 1966. 11 p, 6 tab.

Descriptors: Concrete technology, *Heat of hydration, Cement, Portland cement, Arch dams, Concrete dams, Dam design, Design standards, Clinkers, Chemicals, Chemical engineering, Slags, Industrial plants, Laboratory tests, Minerals, Manufacturing, Hydraulic structures, *Low heat cement, Physical properties, Mechanical properties, Additives, Pozzolans, Fly ash, Specifications, Diatomites.
Identifiers: USSR, Ingursk Dam (USSR), *Exothermic process, Foreign research, Cement efficiencies.

The 4 million cu m of concrete for the 270-m-high Ingursk arch dam, being built in the Caucasus Mountains of the Georgian SSR, must meet very high standards as to deformation and strength (180-day strength of 35 kg/sq cm in tension and 400 in compression). Since none of the plants nearby produced cement of the required quality, especially for low-heat evolution, a program was initiated to develop a cement that would produce concrete of the required quality. Starting with the cements nearest to meeting the requirements, a special Ingursk hydrotechnical cement was developed by substitution of diatomite for a part of the clay component of the clinker, recalcination of the clinker, vibromilling after regular milling, and addition of fly ash. Tests showed that this cement with a coefficient of saturation of 0.84 could be classed as a low-heat cement and that it produced concrete with a compressive strength of 500 kg/sq cm. It was recommended for use in the Ingursk Dam.
W71-05253

8G. Materials

ASHALT DIAPHRAGMS FOR DAMS BUILT OF LOCAL MATERIALS,
Bureau of Reclamation, Denver, Colo.
S. N. Popchenko.
Available from NTIS as PB-193 663, $3.00 in paper copy, $0.95 in microfiche. Translated from: Gidrotekhnichesko Stroitel'stvo No 11, p 15-18,

1969. Bureau of Reclamation Translation No 835, March 1970. 11 p, 4 fig, 22 ref.
Identifiers: *Dams, *Bituminous coatings, *Diaphragms (Mechanics), Dams, Reviews, Leakage (Fluid), Control systems, Inland waterways, Construction, Plastics, Mobility, USSR, Seepage shielding materials, Translations.

Vertical, centrally located asphalt diaphragms in dams of local materials are more advantageous in the northern and high elevation regions: they cut down the volume of imported materials and render the work independent of the season. The success of asphalt diaphragms abroad recommends them for the Soviet Union. Their construction can be simplified by the use of poured asphalt-concrete, and they can be made more reliable by placing an asphalt layer along the axis of the diaphragm with the application of repair-electric heating.
W71-05250

WATER PROBLEMS IN OIL PRODUCTION,
For primary bibliographic entry see Field 05G.
W71-05295

CORROSION AND ITS CONTROL,
Oil and Gas Journal, Tulsa, Okla.
Marshall E. Parker.
Tulsa, Oklahoma, Oil and Gas Journal, 1960. 52 p.

Descriptors: *Corrosion, *Cathodic protection, *Oil industry, Damages, Electroysis, Oxidation, Rusting, Water pollution effects, Well casings, Well screens, Corrosion control, Anodes, Cathodes, Waterproofing.
Identifiers: *Corrosion hot spots, *Cathodic protection principles, Pipe-to-soil potentials, Attenuation curves, Magnesium anodes, Corrosion records, Protective metallic coatings, Corrosion of wells, Weld decay.

The subject of corrosion is a matter of prime concern to people engaged in plant and field operations dealing in the recovery and ultilization of liquid products from oil to ground water, including toxic chemicals. There are a number of anti-corrosion methods available, and there are thousands of individual details which make up the literature and techniques on this subject. Some of these methods are more appropriate under specific conditions than others. Great care is recommended for the selection of the means to be used in a given situation. Once the selection is made, careful attention must be paid to proper application of the method. This operating manual gives, in a series of easy-to-read, one page installments, a large variety of technical information, and helpful pointers in the field of corrosion. (Campbell-NWWA)
W71-05315

WATER WELL INCREASING COSTS OF INSTALLATION AND MAINTENANCE,
Layne Texas Co., Houston, Tex.
F. Dorr, Jr., and A. L. Williams, Jr.
Layne Deep Waters, Vol 3, No 2, p 2-5, June 1968. 8 fig.

Descriptors: *Water wells, *Installation costs, *Corrosion, Initial costs, Equipment, Cathodic protection, Electrolysis, Well screens, Casing.
Identifiers: *Corrosion control theory, *Water system corrosion control, Galvanic corrosion.

The increasing cost of materials and labor has proportionally influenced the cost of water wells. Therefore, extending the service life of a water well has become an increasing factor in the sale of new wells as well as the work-over of existing wells. In an investigation by the Layne Texas Company, the corrosion attack on wells was found to be perhaps the most significant factor of a well's failure. The investigation determined that the corrosion could be mitigated or completely stopped through the application of specifically designed materials. The corrosion of the buried metals of a well is related to the flow of direct electrical current from the metal into the adjacent soil or water. The current flow causes a chemical change in the metal, and results in particles of metal being carried away....corrosion. Preventative measures are discussed. (Campbell-NWWA)
W71-05319

8H. Rapid Excavation

MODEL OF HYDROLOGIC REDISTRIBUTION OF RADIONUCLIDES AROUND NUCLEAR-EXCAVATED SEA-LEVEL CANALS,
Isotopes, Inc., Palo Alto, Calif. Palo Alto Labs.
For primary bibliographic entry see Field 05B.
W71-04882

EXPLOSIVES RESEARCH TO IMPROVE FLOW THROUGH LOW PERMEABILITY ROCK,
Bureau of Mines, Bartlesville, Okla.
J. L. Eakin, and J. S. Miller.
Society of Petroleum Engineers of AIME, Preprint No SPE-1715 1966. 10 p, 16 ref.

Descriptors: *Hydraulics, *Aquifers, Rock mechanics, *Water wells, Rock properties, Transmissivity, Chemical reactions.
Identifiers: *Hydraulic fracturing, *Explosives research, *Rock-blasting mechanism, Explosives research center, Down hole camera.

Small-scale surface tests were conducted to determine the feasibility of using a nitroglycerin base explosive for rock fracture expansion. Preliminary to underground testing, surface and near-surface tests with liquid explosives showed that explosives in sheet-like layers simulating underground fractures would detonate and propagate through the layers. The successful surface tests used layers of explosive confined between glass plates and explosive-saturated sand confined in small diameter metal tubes. In addition, it was shown that explosions propagated through the pores of Berea sandstone saturated with a liquid explosive. Encouraging results were produced by a shallow test in which extensive fracturing was effected by the detonation of 5 3/4 qt of NGl (nitroglycerin) in a vertical crack 4 ft long, 5 ft deep, and 0.1 in. wide in limestone. Fractures 1/4 to 2 in. wide extended 120 ft through the detonation hole. A 50-qt charge of NGl was displaced into a permeable zone at a depth of 42 ft in Green River oil shale. The explosion propagated to test holes drilled on 12 to 15-ft spacing. Effects of the explosion were observed by coring, Caliper logs, Downhole Camera surveys, elevation measurements and air-flow tests. Fracture improvement ratios on 8 test holes, determined from before and after flow tests, ranged from 2.3 to 19.1 and averaged 8.0. (Campbell-NWWA)
W71-05322

10. SCIENTIFIC AND TECHNICAL INFORMATION

AIR POLLUTANTS AFFECTING THE PERFORMANCE OF DOMESTIC ANIMALS - A LITERATURE REVIEW.
Agriculture Research Service, Washington, D.C.
For primary bibliographic entry see Field 05C.
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PERCEPTION OF WATER RESOURCE INFORMATION SOURCES AND EDUCATIONAL NEEDS BY LOCAL OFFICIALS AND SPECIAL INTEREST GROUPS,
North Carolina State Univ., Raleigh. Dept. of Adult and Community Coll. Education; and North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 06B.
W71-04933

POTENTIAL ALGICIDES FOR THE CONTROL OF ALGAE,
Los Angeles County Sanitation District, Calif.
For primary bibliographic entry see Field 05G.
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C. Others	
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Environmental Protection Agency, Water Quality Office	W71-05143

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CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE

- Ground and surface water hydrology at the Water Resources Division of the U. S. Geological Survey, U. S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the EPA-Water Quality Office, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.

Supported by the Environmental Protection Agency in cooperation with WRSIC.

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.
- Methods for chemical and biological identification and measurement of pollutants at the Analytical Quality Control Laboratory of the Water Quality Office of the Environmental Protection Agency.
- Coastal pollution at the Oceanic Research Institute.

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- WATER SUPPLY AUGMENTATION AND CONSERVATION
- WATER QUANTITY MANAGEMENT AND CONTROL
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